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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S APPLICATION NO (If known see 37 C F R 1.5)
09/ 674651

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	(EARLIEST) PRIORITY DATE CLAIMED
PCT/JP00/01272	**03 March 2000**	**03 March 1999**

TITLE OF INVENTION **RECORDING APPARATUS, RECORDING METHOD, REPRODUCING APPARATUS, AND REPRODUCING METHOD**

APPLICANTS FOR DO/EO/US **Nobuyuki KIHARA, Teppei YOKOTA and Takumi OKAUE**

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)), including 32 sheets of formal drawings and a copy of the International Search Report.
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventors (35 U.S.C. 371(c)(4)).
10. ☐ The annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
    PCT/ISA/210, PCT/RO/101
    References for IDS

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17. ☒ The following fees are submitted: (CALCULATIONS /PTO USE ONLY

Basic National Fee (37 CFR 1.492(a)(1)-(5):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO... ... $1000.00

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Attorney Docket No. 450106-02443

New Patent Application filed **November 2, 2000**, entitled:

RECORDING APPARATUS, RECORDING METHOD,

REPRODUCING METHOD, REPRODUCING APPARATUS,

AND REPRODUCING METHOD

corresponding to PCT Application No. PCT/JP00/01272

filed March 3, 2000

Express Mail No.: EL585029805US

Date of Deposit: November 2, 2000

I hereby certify that this application and the accompanying papers are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to:

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32/PRTS

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DESCRIPTION

Recording Apparatus, Recording Method, Reproducing Apparatus, and Reproducing Method

Technical Field

The present invention relates to a recording apparatus, a recording method, a reproducing apparatus, and a reproducing method that permit or prohibit a decompressing process depending on whether or not fixed value data that has been placed in each segmented block of a compressed digital signal and encrypted can be completely decrypted.

Related Art

EEPROM (Electrically Erasable Programmable ROM) that is an electrically rewritable memory requires a large space because each bit is composed of two transistors. Thus, the integration of EEPROM is restricted. To solve this problem, a flash memory that allows one bit to be accomplished with one transistor using all-bit-erase system has been developed. The flash memory is being expected as a successor of conventional record mediums such as magnetic disks and optical discs.

A memory card using a flash memory is also known. The memory card can be freely attached to an

apparatus and detached therefrom. A digital audio recording/reproducing apparatus that uses a memory card instead of a conventional CD (Compact Disc: Trademark) or MD (Mini Disc: Trademark) can be accomplished and a digital audio data that uses the memory card can be recorded and reproduced.

A file management system used for a conventional personal computer is named FAT (File Allocation Table). In the FAT system, when a particular file is defined, predetermined parameters are successively set to the file. Thus, the size of a file becomes variable. One file is composed of at least one management unit (sector, cluster, or the like). Data corresponding to the management unit is written to a table referred to as FAT. In the FAT file system, a file structure can be easily formed regardless of the physical characteristics of a record medium. Thus, the FAT file system can be used for a magneto-optical disc as well as a floppy disk and a hard disk. In the above-mentioned memory card, the FAT file system is used.

In recent years, with respect to digital recording of music data, the rights of copyright owners should be adequately protected. In other words, using technologies of personal computers, digital music data can be easily copied. To prevent digital music data from being illegally copied, a next generation audio

data that is encrypted has been proposed.

When audio data is encrypted, it is randomized. Thus, even if the reproduced output data is abnormal due to a particular cause of the recorder, it is difficult to detect the abnormality of the output data. If the abnormality of the reproduced output data cannot be detected, noise such as click sound hurts the ears of the user. Alternatively, the noise may damage the speakers.

Therefore, an object of the present invention is to provide a recording apparatus, a recording method, a reproducing apparatus, and reproducing method that prevent abnormally reproduced output data from being output even in the case that audio data is encrypted.

Disclosure of the Invention

A first aspect of the present invention is a recording apparatus, comprising a compression process means for compressing an input digital signal corresponding to a predetermined compression process and segmenting the compressed digital signal into blocks, a fixed value generating means for generating a predetermined fixed value, an adding means for adding the fixed value generated by the fixed value generating means at a predetermined timing to the blocks of the digital signal compressed by the compression process

means, an encrypting means for encrypting the fixed value and the compressed digital signal added by the adding means, and a recording means for recording the fixed value and the compressed digital signal encrypted by the encrypting means to a record medium.

A second aspect of the present invention is a reproducing apparatus for reproducing data of which a digital signal of which a fixed value is added at a predetermined timing to blocks of main data is compressed and encrypted from a record medium, comprising a decrypting means for decrypting the compressed and encrypted digital signal, a separating means for separating the fixed value and the compressed data from the digital signal that are decrypted by the decrypting means, a decompressing means for decompressing the compressed main data separated by the separating means, a memory means for pre-storing a fixed value, a comparing means for comparing the fixed value separated by the separating means with the fixed value stored in the memory means, and a controlling means for permitting and prohibiting the decompressing process of the decompressing means for the main data decompressed by the decompressing means corresponding to the compared result of the comparing means.

According to the present invention, one block as an erase unit of an attachable/detachable non-volatile memory contains a header and a plurality of

sound units SU. The first one byte of the first sound unit SU of the block is read. The high order six bits of the one byte are compared with a predetermined code (fixed value). When they match, it is determined that the reproduced output is not abnormal. On the other hand, when they do not match, it is determined that the reproduced output data is abnormal. When the determined result represents that the reproduced output data is abnormal, the reproduced sound is muted. On the other hand, when data is reproduced, an alarm is issued. Alternatively, the system is reset so that the user determines whether or not the abnormality of the reproduced output data is solved.

Brief Description of Drawings

Fig. 1 is a block diagram showing the structure of a digital audio recorder/player using a non-volatile memory card according to the present invention; Fig. 2 is a block diagram showing the internal structure of a DSP 30 according to the present invention; Fig. 3 is a block diagram showing the internal structure of a memory card 40 according to the present invention; Fig. 4 is a schematic diagram showing a file management structure of a memory card as a storage medium according to the present invention; Fig. 5 is a schematic diagram showing the physical structure of data in a flash memory 42 of the memory

card 40 according to the present invention; Fig. 6 is a data structure of the memory card 40 according to the present invention; Fig. 7 is a schematic diagram showing the hierarchy of the file structure in the memory card 40; Fig. 8 is a schematic diagram showing the data structure of a reproduction management file PBLIST.MSF that is a sub directory stored in the memory card 40; Fig. 9 is a schematic diagram showing the data structure in the case that one ATRAC3 data file is divided into blocks with a predetermined unit length and that attribute files are added thereto; Fig. 10A is a schematic diagram showing the file structure before two files are edited with a combining process; Fig. 10B is a schematic diagram showing the file structure after two files are edited with a combining process; Fig. 10C is a schematic diagram showing the file structure after one file is edited with a dividing process; Fig. 11 is a schematic diagram showing the data structure of a reproduction management file PBLIST; Fig. 12A is a schematic diagram showing the data structure of a header portion of the reproduction management file PBLIST; Fig. 12B is a schematic diagram showing the data structure of a main data portion of the reproduction management file PBLIST; Fig. 12C is a schematic diagram showing the data structure of an additional information data portion of the reproduction management file PBLIST; Fig. 13 is a table that

correlates types of additional information data and code values thereof; Fig. 14 is a table that correlates types of additional information data and code values thereof; Fig. 15 is a table that correlates types of additional information data and code values thereof; Fig. 16A is a schematic diagram showing the data structure of additional information data; Fig. 16B is a schematic diagram showing the data structure in the case that additional information data is an artist name; Fig. 16C is a schematic diagram showing the data structure in the case that additional information data is a copyright code; Fig. 16D is a schematic diagram showing the data structure in the case that additional information data is date/time information; Fig. 16E is a schematic diagram showing the data structure in the case that additional information data is a reproduction log; Fig. 17 is a schematic diagram showing a detailed data structure of an ATRAC3 data file; Fig. 18 is a schematic diagram showing the data structure of an upper portion of an attribute header that composes an ATRAC3 data file; Fig. 19 is a schematic diagram showing the data structure of a middle portion of the attribute header that composes an ATRAC3 data file; Fig. 20 is a table that correlates record modes, record time, and so forth; Fig. 21 is a table showing copy control states; Fig. 22 is a schematic diagram showing the data structure of a lower portion of the attribute

header that composes an ATRAC3 data file; Fig. 23 is a schematic diagram showing the data structure of a header of a data block of an ATRAC3 data file; Figs. 24A to 24C are flow charts showing a recovering method according to the present invention in the case that an FTA area was destroyed; Fig. 25 is a schematic diagram showing the file structure in the memory card 40 according to a second embodiment of the present invention; Fig. 26 is a schematic diagram showing the relation between a track information management file TRKLIST.MSF and an ATRAC3 data file A3Dnnnnn.MSA; Fig. 27 is a schematic diagram showing the detailed data structure of the track information management file TRKLIST.MSF; Fig. 28 is a schematic diagram showing the detailed data structure of NAME1 for managing a name; Fig. 29 is a schematic diagram showing the detailed data structure of NAME2 for managing a name; Fig. 30 is a schematic diagram showing the detailed data structure of an ATRAC3 data file A3Dnnnnn.MSA; Fig. 31 is a schematic diagram showing the detailed data structure of INFLIST.MSF that represents additional information; Fig. 32 is a schematic diagram showing the detailed data structure of INFLIST.MSF that represents additional information data; Fig. 33 is a flow chart showing a recovering method according to the second embodiment of the present invention in the case that an FTA area was destroyed; Fig. 34 is a block diagram

showing the structure of a modulating and demodulating unit; Fig. 35 is a schematic diagram showing the data structure of which a fixed value is added at intervals of a sound unit SU; Fig. 36 is a block diagram showing the structure of a decrypting unit; and Fig. 37 is a block diagram showing the structure of a recording and reproducing apparatus.

Best Modes for Carrying out the Invention

Next, an embodiment of the present invention will be described. Fig. 1 is a block diagram showing the structure of a digital audio recorder/player using a memory card according to an embodiment of the present invention. The digital audio recorder/player records and reproduces a digital audio signal using a detachable memory card. In reality, the recorder/player composes an audio system along with an amplifying unit, a speaker, a CD player, an MD recorder, a tuner, and so forth. However, it should be noted that the present invention can be applied to other audio recorders. In other words, the present invention can be applied to a portable recording/reproducing apparatus. In addition, the present invention can be applied to a set top box that records a digital audio data that is circulated as a satellite data communication, a digital broadcast, or Internet. Moreover, the present invention can be

applied to a system that records/reproduces moving picture data and still picture data rather than audio data. The system according to the embodiment of the present invention can record and reproduce additional information such as picture and text other than a digital audio signal.

The recording/reproducing apparatus has an audio encoder/decoder IC 10, a security IC 20, a DSP (Digital Signal Processor) 30. Each of these devices is composed of a one-chip IC. The recording/reproducing apparatus has a detachable memory card 40. The one-chip IC of the memory card 40 has flash memory (nonvolatile memory), a memory control block, and a security block. The security block has a DES (Data Encryption Standard) encrypting circuit. According to the embodiment, the recording/reproducing apparatus may use a microcomputer instead of the DSP 30.

The audio encoder/decoder IC 10 has an audio interface 11 and an encoder/decoder block 12. The encoder/decoder block 12 encodes a digital audio data corresponding to a highly efficient encoding method and writes the encoded data to the memory card 40. In addition, the encoder/decoder block 12 decodes encoded data that is read from the memory card 40. As the highly efficient encoding method, the ATRAC3 format that is a modification of the ATRAC (Adaptive Transform

Acoustic Coding) format used in Mini-Disc is used.

In the ATRAC3 format, audio data sampled at 44.1 kHz and quantized with 16 bits is highly efficiently encoded. In the ATRAC3 format, the minimum data unit of audio data that is processed is a sound unit (SU). 1 SU is data of which data of 1024 samples (1024 x 16 bits x 2 channels) is compressed to data of several hundred bytes. The duration of 1 SU is around 23 msec. In the highly efficient encoding method, the data amount of audio data is compressed to data that is around 10 times smaller than that of original data. As with the ATRAC1 format used in Mini-Disc, the audio signal compressed and decompressed corresponding to the ATRAC3 format less deteriorates in the audio quality.

A line input selector 13 selectively supplies the reproduction output signal of an MD, the output signal of a tuner, or a reproduction output signal of a tape to an A/D converter 14. The A/D converter 14 converts the input line signal to a digital audio signal (sampling frequency = 44.1 kHz; the number of quantizing bits = 16). A digital input selector 16 selectively supplies a digital output signal of an MD, a CD, or a CS (Satellite Digital Broadcast) to a digital input receiver 17. The digital input signal is transmitted through for example an optical cable. An output signal of the digital input receiver 17 is supplied to a sampling rate converter 15. The sampling

rate converter 15 converts the digital input signal into a digital audio signal (sampling frequency = 44.1 kHz; the number of quantizing bits = 16).

The encoder/decoder block 12 of the audio encoder/decoder IC 10 supplies encoded data to a DES encrypting circuit 22 through an interface 21 of the security IC 20. The DES encrypting circuit 22 has a FIFO 23. The DES encrypting circuit 22 is disposed so as to protect the copyright of contents. The memory card 40 also has a DES encrypting circuit. The DES encrypting circuit 22 of the recording/reproducing apparatus has a plurality of master keys and an apparatus-unique storage key. The DES encrypting circuit 22 also has a random number generating circuit. The DES encrypting circuit 22 can share an authenticating process and a session key with the memory card 40 that has the DES encrypting circuit. In addition, the DES encrypting circuit 22 can re-encrypt data with the storage key of the DES encrypting circuit.

The encrypted audio data that is output from the DES encrypting circuit 22 is supplied to a DSP (Digital Signal Processor) 30. The DSP 30 communicates with the memory card 40 through an interface. In this example, the memory card 40 is attached to an attaching/detaching mechanism (not shown) of the recording/reproducing apparatus. The DSP 30 writes the

encrypted data to the flash memory of the memory card 40. The encrypted data is serially transmitted between the DSP 30 and the memory card 40. In addition, an external SRAM (Static Random Access Memory) 31 is connected to the DSP 30. The SRAM 31 provides the recording/reproducing apparatus with a sufficient storage capacity so as to control the memory card 40.

A bus interface 32 is connected to the DSP 30. Data is supplied from an external controller (not shown) to the DSP 30 through a bus 33. The external controller controls all operations of the audio system. The external controller supplies data such as a record command or a reproduction command that is generated corresponding to a user's operation through an operation portion to the DSP 30 through the bus interface 32. In addition, the external controller supplies additional information such as image information and character information to the DSP 30 through the bus interface 32. The bus 33 is a bidirectional communication path. Additional information that is read from the memory card 40 is supplied to the external controller through the DSP 30, the bus interface 32, and the bus 33. In reality, the external controller is disposed in for example an amplifying unit of the audio system. In addition, the external controller causes a display portion to display additional information, the operation state of the

recorder, and so forth. The display portion is shared by the audio system. Since data that is exchanged through the bus 33 is not copyright protected data, it is not encrypted.

The encrypted audio data that is read from the memory card 40 by the DSP 30 is decrypted by the security IC 20. The audio encoder/decoder IC 10 decodes the encoded data corresponding to the ATRAC3 format. Output data of the audio encoder/decoder 10 is supplied to a D/A converter 18. The D/A converter 18 converts the output data of the audio encoder/decoder 10 into an analog signal. The analog audio signal is supplied to a line output terminal 19.

The analog audio signal is supplied to an amplifying unit (not shown) through the line output terminal 19. The analog audio signal is reproduced from a speaker or a head set. The external controller supplies a muting signal to the D/A converter 18. When the muting signal represents a mute-on state, the external controller prohibits the audio signal from being output from the line output terminal 19.

Fig. 2 is a block diagram showing the internal structure of the DSP 30. Referring to Fig. 2, the DSP 30 comprises a core 34, a flash memory 35, an SRAM 36, a bus interface 37, a memory card interface 38, and inter-bus bridges. The DSP 30 has the same function as a microcomputer. The core 34 is equivalent

to a CPU. The flash memory 35 stores a program that causes the DSP 30 to perform predetermined processes. The SRAM 36 and the external SRAM 31 are used as a RAM of the recording/reproducing apparatus.

The DSP 30 controls a writing process for writing encrypted audio data and additional information to the memory card 40 corresponding to an operation signal such as a record command received through the bus interfaces 32 and 37 and a reading process for reading them therefrom. In other words, the DSP 30 is disposed between the application software side of the audio system that records/reproduces audio data and additional information and the memory card 40. The DSP 30 is operated when the memory card 40 is accessed. In addition, the DSP 30 is operated corresponding to software such as a file system.

The DSP 30 manages files stored in the memory card 40 with the FAT system used in conventional personal computers. In addition to the file system, according to the embodiment of the present invention, a management file is used. The management file will be descried later. The management file is used to manage data files stored in the memory card 40. The management file as the first file management information is used to manage audio data files. On the other hand, the FAT as the second file management information is used to mange all files including audio

data files and management files stored in the flash memory of the memory card 40. The management file is stored in the memory card 40. The FAT is written to the flash memory along with the route directory and so forth before the memory card 40 is shipped. The details of the FAT will be described later.

According to the embodiment of the present invention, to protect the copyright of data, audio data that has been compressed corresponding to the ATRAC3 format is encrypted. On the other hand, since it is not necessary to protect the copyright of the management file, it is not encrypted. There are two types of memory cards that are an encryption type and a non-encryption type. However, a memory card for use with the recorder/player that records copyright protected data is limited to the encryption type.

Voice data and image data that are recorded by users are recorded on non-encryption type memory cards.

Fig. 3 is a block diagram showing the internal structure of the memory card 40. The memory card 40 comprises a control block 41 and a flash memory 42 that are structured as a one-chip IC. A bidirectional serial interface is disposed between the DSP 30 of the recorder/player and the memory card 40. The bidirectional serial interface is composed of ten lines that are a clock line SCK for transmitting a

clock signal that is transmitted along with data, a status line SBS for transmitting a signal that represents a status, a data line DIO for transmitting data, an interrupt line INT, two GND lines, two INT lines, and two reserved lines.

The clock line SCK is used for transmitting a clock signal in synchronization with data. The status line SBS is used for transmitting a signal that represents the status of the memory card 40. The data line DIO is used for inputting and outputting a command and encrypted audio data. The interrupt line INT is used for transmitting an interrupt signal that causes the memory card 40 to interrupt the DSP 30 of the recorder/player. When the memory card 40 is attached to the recorder/player, the memory card 40 generates the interrupt signal. However, according to the embodiment of the present invention, since the interrupt signal is transmitted through the data line DIO, the interrupt line INT is grounded.

A serial/parallel converting, parallel/serial converting, and interface block (S/P, P/S, I/F block) 43 is an interface disposed between the DSP 30 of the recorder/player and the control block 41 of the memory card 40. The S/P, P/S, and IF block 43 converts serial data received from the DSP 30 of the recorder/player into parallel data and supplies the parallel data to the control block 41. In addition, the S/P, P/S, and

IF block 43 converts parallel data received from the control block 41 into serial data and supplies the serial data to the DSP 30. When the S/P, P/S, and IF block 43 receives a command and data through the data line DIO, the S/P, P/S, and IF block 43 separates them into these that are normally accessed to the flash memory 42 and those that are encrypted.

In the format of which data is transmitted through the data line DIO, after a command is transmitted, data is transmitted. The S/P, P/S, and IF block 43 detects the code of a command and determines whether the command and data are those that are normally accessed or those that are encoded. Corresponding to the determined result, the S/P, P/S, and IF block 43 stores a command that is normally accessed to a command register 44 and stores data that is normally accessed to a page buffer 45 and a write register 46. In association with the write register 46, the memory card 40 has an error correction code encoding circuit 47. The error correction code encoding circuit 47 generates a redundant code that is an error correction code for data temporarily stored in the page buffer 45.

Output data of the command register 44, the page buffer 45, the write register 46, and the error correction code encoding circuit 47 is supplied to a flash memory interface and sequencer (hereinafter,

referred to as memory I/F and sequencer) 51. The memory IF and sequencer 51 is an interface disposed between the control block 41 and the flash memory 42 and controls data exchanged therebetween. Data is written to the flash memory through the memory IF and sequencer 51.

Audio data that has been compressed corresponding to the ATRAC3 format and written to the flash memory (hereinafter, this audio data is referred to as ATRAC3 data) is encrypted by the security IC 20 of the recorder/player and the security block 52 of the memory card 40 so as to protect the copyright of the ATRAC3 data. The security block 52 comprises a buffer memory 53, a DES encrypting circuit 54, and a nonvolatile memory 55.

The security block 52 of the memory card 40 has a plurality of authentication keys and a unique storage key for each memory card. The nonvolatile memory 55 stores a key necessary for encrypting data. The key stored in the nonvolatile memory 55 cannot be analyzed. According to the embodiment, for example, a storage key is stored in the nonvolatile memory 55. The security block 52 also has a random number generating circuit. The security block 52 authenticates an applicable recorder/player and shares a session key therewith. In addition, the security block 52 re-encrypts contents with the storage key

through the DSE encrypting circuit 54.

For example, when the memory card 40 is attached to the recorder/player, they are mutually authenticated. The security IC 20 of the recorder/player and the security block 52 of the memory card 40 mutually authenticate. When the recorder/player has authenticated the attached memory card 40 as an applicable memory card and the memory card 40 has authenticated the recorder/player as an applicable recorder/player, they are mutually authenticated. After the mutual authenticating process has been successfully performed, the recorder/player and the memory card 40 generate respective session keys and share them with each other. Whenever the recorder/player and the memory card 40 authenticate each other, they generate respective session keys.

When contents are written to the memory card 40, the recorder/player encrypts a contents key with a session key and supplies the encrypted data to the memory card 40. The memory card 40 decrypts the contents key with the session key, re-encrypts the contents key with a storage key, and supplies the contents key to the recorder/player. The storage key is a unique key for each memory card 40. When the recorder/player receives the encrypted contents key, the recorder/player performs a formatting process for the encrypted contents key, and writes the encrypted

contents key and the encrypted contents to the memory card 40.

In the above section, the writing process for the memory card 40 was described. In the following, the reading process for the memory card 40 will be described. Data that is read from the flash memory 42 is supplied to the page buffer 45, the read register 48, and the error correction circuit 49 through the memory IF and the sequencer 51. The error correcting circuit 49 corrects an error of the data stored in the page buffer 45. Output data of the page buffer 45 that has been error-corrected and the output data of the read register 48 are supplied to the S/P, P/S, and IF block 43. The output data of the S/P, P/S, and IF block 43 is supplied to the DSP 30 of the recorder/player through the above-described serial interface.

When data is read from the memory card 40, the contents key encrypted with the storage key and the contents encrypted with the block key are read from the flash memory 42. The security block 52 decrypts the contents key with the storage key. The security block 52 re-encrypts the decrypted content key with the session key and transmits the re-encrypted contents key to the recorder/player. The recorder/player decrypts the contents key with the received session key and generates a block key with the decrypted contents key.

The recorder/player successively decrypts the encrypted ATRAC3 data.

A config. ROM 50 is a memory that stores partition information, various types of attribute information, and so forth of the memory card 40. The memory card 40 also has an erase protection switch 60. When the switch 60 is in the erase protection position, even if a command that causes the memory card 40 to erase data stored in the flash memory 42 is supplied from the recorder/player side to the memory card 40, the memory card 40 is prohibited from erasing the data stored in the flash memory 42. An OSC cont. 61 is an oscillator that generates a clock signal that is the reference of the timing of the process of the memory card 40.

Fig. 4 is a schematic diagram showing the hierarchy of the processes of the file system of the computer system that uses a memory card as a storage medium. On the hierarchy, the top hierarchical level is an application process layer. The application process layer is followed by a file management process layer, a logical address management layer, a physical address management layer, and a flash memory access layer. In the above-mentioned hierarchical structure, the file management process layer is the FAT file system. Physical addresses are assigned to individual blocks of the flash memory. The relation between the

blocks of the flash memory and the physical addresses thereof does not vary. Logical addresses are addresses that are logically handled on the file management process layer.

Fig. 5 is a schematic diagram showing the physical structure of data handled in the flash memory 42 of the memory card 40. In the memory 42, a data unit (referred to as segment) is divided into a predetermined number of blocks (fixed length). One block is divided into a predetermined number of pages (fixed length). In the flash memory, data is erased as each block at a time. Data is written to the flash memory 42 or read therefrom as a page at a time. The size of each block is the same. Likewise, the size of each page is the same. One block is composed of page 0 to page m. For example, one block has a storage capacity of for example 8 KB (kilobytes) or 16 KB. One page has a storage capacity of 512 B (bytes). When one block has a storage capacity of 8 KB, the total storage capacity of the flash memory 42 is 4 MB (512 blocks) or 8 MB (1024 blocks). When one block has a storage capacity of 16 KB, the total storage capacity of the flash memory 42 is 16 MB (1024 blocks), 32 MB (2048 blocks), or 64 MB (4096 blocks).

One page is composed of a data portion of 512 bytes and a redundant portion of 16 bytes. The first three bytes of the redundant portion is an overwrite

portion that is rewritten whenever data is updated. The first three bytes successively contain a block status area, a page status area, and an update status area. The remaining 13 bytes of the redundant portion are fixed data that depends on the contents of the data portion. The 13 bytes contain a management flag area (1 byte), a logical address area (2 bytes), a format reserve area (5 bytes), a dispersion information ECC area (2 bytes), and a data ECC area (3 bytes). The dispersion information ECC area contains redundant data for an error correction process against the management flag area, the logical address area, and the format reserve area. The data ECC area contains redundant data for an error correction process against 512-byte data.

The management flag area contains a system flag (1: user block, 0: boot block), a conversion table flag (1: invalid, 0: table block), a copy prohibition flag (1: OK, 0: NG), and an access permission flag (1: free, 0: read protect).

The first two blocks - blocks 0 and 1 are boot blocks. The block 1 is a backup of the block 0. The boot blocks are top blocks that are valid in the memory card. When the memory card is attached to the recorder/player, the boot blocks are accessed at first. The remaining blocks are user blocks. Page 0 of the boot block contains a header area, a system entry area,

and a boot and attribute information area. Page 1 of the boot block contains a prohibited block data area. Page 2 of the boot block contains a CIS (Card Information Structure)/IDI (identify Drive Information) area.

The header area of the boot block contains a boot block ID and the number of effective entries. The system entries are the start position of prohibited block data, the data size thereof, the data type thereof, the data start position of the CIS/IDI area, the data size thereof, and the data type thereof. The boot and attribute information contains the memory card type (read only type, rewritable type, or hybrid type), the block size, the number of blocks, the number of total blocks, the security/non-security type, the card fabrication data (date of fabrication), and so forth.

Since the flash memory has a restriction for the number of rewrite times due to the deterioration of the insulation film, it is necessary to prevent the same storage area (block) from being concentratedly accessed. Thus, when data at a particular logical address stored at a particular physical address is rewritten, updated data of a particular block is written to a non-used block rather than the original block. Thus, after data is updated, the relation between the logical address and the physical address changes. This process is referred to as swap process.

Consequently, the same block is prevented from being concentratedly accessed. Thus, the service life of the flash memory can be prolonged.

The logical address associates with data written to the block. Even if the block of the original data is different from the block of updated data, the address on the FAT does not change. Thus, the same data can be properly accessed. However, since the swap process is performed, a conversion table that correlates logical addresses and physical addresses is required (this table is referred to as logical-physical address conversion table). With reference to the logical-physical address conversion table, a physical address corresponding to a logical address designated on the FAT is obtained. Thus, a block designated with a physical address can be accessed.

The DSP 30 stores the logical-physical address conversion table in the SRAM. When the storage capacity of the RAM is small, the logical-physical address conversion table can be stored to the flash memory. The logical-physical address conversion table correlates logical addresses (2 bytes) sorted in the ascending order with physical addresses (2 bytes). Since the maximum storage capacity of the flash memory is 128 MB (8192 blocks), 8192 addresses can be assigned with two bytes. The logical-physical address conversion table is managed for each segment. Thus,

the size of the logical-physical address conversion table is proportional to the storage capacity of the flash memory. When the storage capacity of the flash memory is 8 MB (two segments), two pages are used as the logical-physical address conversion table for each of the segments. When the conversion table is stored in the flash memory, a predetermined one bit of the management flag area in the redundant portion in each page represents whether or not the current block is a block containing the logical-physical address conversion table.

The above-described memory card can be used with the FAT file system of a personal computer system as with the disc shaped record medium. The flash memory has an IPL area, a FAT area, and a route directory area (not shown in Fig. 5). The IPL area contains the address of a program to be initially loaded to the memory of the recorder/player. In addition, the IPL area contains various types of memory information. The FAT area contains information with respect to blocks (clusters). The FAT has defined unused blocks, next block number, defective blocks, and last block number. The route directory area contains directory entries that are a file attribute, an update date [day, month, year], file size, and so forth.

Next, with reference to Fig. 6, a managing method using the FAT table will be described.

Fig. 6 is a schematic diagram showing a memory map. The top area of the memory map is a partition table portion. The partition table portion is followed by a block area, a boot sector, a FAT area, a FAT backup area, a root directory area, a sub directory area, and a data area. On the memory map, logical addresses have been converted into physical addresses corresponding to the logical-physical address conversion table.

The boot sector, the FAT area, the FAT backup area, the root directory area, the sub directory area, and the data area are referred to as FAT partition area.

The partition table portion contains the start address and the end address of the FAT partition area.

The FAT used for a conventional floppy disk does not have such a partition table. Since the first track has only a partition table, there is a blank area. The boot sector contains the size of the FAT structure (12 bit FAT or 16 bit FAT), the cluster size, and the size of each area. The FAT is used to manage the position of a file recorded in the data area. The FAT copy area is a FAT backup area. The route directory area contains file names, start cluster addresses thereof, and various attributes thereof. The route directory area uses 32 bytes per file.

The sub directory area is achieved by a directory attribute file as a directory. In the embodiment shown in Fig. 6, the sub directory area has four files named PBLIST.MSF, CAT.MSF, DOG.MSF, and MAN.MFA. The sub directory area is used to manage file names and record positions on the FAT. In other words, the slot of the file name CAT.MSF is assigned address "10" on the FAT. The slot of the file name DOG.MSF is assigned address "10" on the FAT. An area after cluster 2 is used as a data area. In this embodiment, audio data that has been compressed corresponding to the ATRAC3 format is recorded. The top slot of the file name MAN.MSA is assigned address "110" on the FAT. According to the embodiment of the present invention, audio data with the file name CAT.MSF is recorded to cluster 5 to 8. Audio data of DOG-1 as the first half of the file with the file name DOG.MSF is recorded to clusters 10 to 12. Audio data DOG-2 as the second half of the file with the file name DOG.MSF is recorded in clusters 100 and 101. Audio data with the file name MAN.MSF is recorded in clusters 110 and 111.

In the embodiment of the present invention, an example of which a single file is divided into two portions and dispersedly recorded is described. In the embodiment, an area "Empty" in the data area is a recordable area. An area after cluster 200 is used for managing file names. The file CAT.MSF is recorded to

cluster 200. The file DOG.MSF is recorded to cluster 201. The file MAN.MSF is recorded to cluster 202. When the positions of the files are changed, the area after cluster 200 is re-arranged. When the memory card is attached, the beginning and the end of the FAT partition area are recorded with reference to the top partition table portion. After the boot sector portion is reproduced, the root directory area and the sub directory area are reproduced. The slot of the reproduction management information PBLIST.MSF in the sub directory area is detected. Thus, the address of the end portion of the slot of the file PBLIST.MSF is obtained. In the embodiment, since address "200" is recorded at the end of the file PBLIST.MSF, cluster 200 is referenced.

The area after cluster 200 is used for managing the reproduction order of files. In the embodiment, the file CAT.MSA is the first program. The file DOG.MSA is the second program. The file MAN.MSA is the third program. After the area after cluster 200 is referenced, slots of the files CAT.MSA, DOG.MSA, and MAN.MSA are referenced. In Fig. 6, the end of the slot of the file CAT.MSA is assigned address "5". The end of the slot of the file DOG.MSA is assigned address "10". The end of the slot of the file MAN.MSA is assigned address "110". When an entry address is searched on the FAT with address "5", cluster address

"6" is obtained. When an entry address is searched on the FAT with address "6", cluster address "7" is obtained. When an entry address is searched on the FAT with address "8", code "FFF" that represents the end is obtained. Thus, the file CAT.MSA uses clusters 5, 6, 7, and 8. With reference to clusters 5, 6, 7, and 8 in the data area, an area of ATRAC3 data with the file name CAT.MSA can be accessed.

Next, a method for searching the file DOG.MSF that has been dispersedly recorded will be described. The end of the slot of the file DOG.MSA is assigned address "10". When an entry address on the FAT is searched with address "10", cluster address "11" is obtained. When an entry address on the FAT is searched with address "11" is referenced, cluster address "12" is obtained. When an entry address on the FAT is searched with address "12" is referenced, cluster address "101" is obtained. When entry address "101" is referenced, code "FFF" that represents the end is obtained. Thus, the file DOG.MSF uses clusters 10, 11, 12, 100, and 101. When clusters 10, 11, and 12 are referenced, the first part of ATRAC3 data of the file DOG.MSF can be accessed. When the clusters 100 and 101 are referenced, the second part of ATRAC3 data of the file DOG.MSF can be accessed. In addition, when an entry address is searched on the FAT with address "110", cluster address "101" is obtained. When an

entry address "111" is searched on the FAT with address "101", code "FFF" that represents the end is obtained. Thus, it is clear that the file MAN.MSA uses clusters 110 and 111. As described above, data files dispersed in the flash memory can be linked and sequentially reproduced.

According to the embodiment of the present invention, in addition to the file management system defined in the format of the memory card 40, the management file is used for managing tracks and parts of music files. The management file is recorded to a user block of the flash memory 42 of the memory card 40. Thus, as will be described later, even if the FAT of the memory card 40 is destroyed, a file can be recovered.

The management file is generated by the DSP 30. When the power of the recorder/player is turned on, the DSP 30 determines whether or not the memory card 40 has been attached to the recorder/player. When the memory card has been attached, the DSP 30 authenticates the memory card 40. When the DSP 30 has successfully authenticated the memory card 40, the DSP 30 reads the boot block of the flash memory 42. Thus, the DSP 30 reads the physical-logical address conversion table and stores the read data to the SRAM. The FAT and the route directory have been written to the flash memory of the memory card 40 before the

memory card 40 is shipped. When data is recorded to the memory card 40, the management file is generated.

In other words, a record command issued by the remote controller of the user or the like is supplied to the DSP 30 from the external controller through the bus and the bus interface 32. The encoder/decoder IC 10 compresses the received audio data and supplies the resultant ATRAC3 data to the security IC 20. The security IC 20 encrypts the ATRAC3 data. The encrypted ATRAC3 data is recorded to the flash memory 42 of the memory card 40. Thereafter, the FAT and the management file are updated. Whenever a file is updated (in reality, whenever the recording process of audio data is completed), the FAT and the management file stored in the SRAMs 31 and 36 are rewritten. When the memory card 40 is detached or the power of the recorder/player is turned off, the FAT and the management file that are finally supplied from the SRAMs 31 and 36 are recorded to the flash memory 42. Alternatively, whenever the recording process of audio data is completed, the FAT and the management file written in the flash memory 42 may be rewritten. When audio data is edited, the contents of the management file are updated.

In the data structure according to the embodiment, additional information is contained in the management file. The additional information is updated

and recorded to the flash memory 42. In another data structure of the management file, an additional information management file is generated besides the track management file. The additional information is supplied from the external controller to the DSP 30 through the bus and the bus interface 32. The additional information is recorded to the flash memory 42 of the memory card 40. Since the additional information is not supplied to the security IC 20, it is not encrypted. When the memory card 40 is detached from the recorder/player or the power thereof is turned off, the additional information is written from the SRAM of the DSP 30 to the flash memory 42.

Fig. 7 is a schematic diagram showing the file structure of the memory card 40. As the file structure, there are a still picture directory, a moving picture directory, a voice directory, a control directory, and a music (HIFI) directory. According to the embodiment, music programs are recorded and reproduced. Next, the music directory will be described. The music directory has two types of files. The first type is a reproduction management file BLIST.MSF (hereinafter, referred to as PBLIST). The other type is an ATRAC3 data file A3Dnnnn.MSA that stores encrypted music data. The music directory can stores up to 400 ATRAC3 data files (namely, 400 music programs). ATRAC3 data files are registered to the

reproduction management file and generated by the recorder/player.

Fig. 8 is a schematic diagram showing the structure of the reproduction management file. Fig. 9 is a schematic diagram showing the file structure of one ATRAC3 data file. The reproduction management file is a fixed-length file of 16 KB. An ATRAC3 data file is composed of an attribute header and an encrypted music data area for each music program. The attribute data has a fixed length of 16 KB. The structure of the attribute header is similar to that of the reproduction management file.

The reproduction management file shown in Fig. 8 is composed of a header, a memory card name NM-1S (for one byte code), a memory card name NM2-S (for two byte code), a program reproduction sequence table TRKTBL, and memory card additional information INF-S. The attribute header (shown in Fig. 9) at the beginning of the data file is composed of a header, a program name NM1 (for one byte code), a program name NM2 (for two byte code), track information TRKINF (such as track key information), part information PRTINF, and track additional information INF. The header contains information of the number of total parts, the attribute of the name, the size of the additional information, and so forth.

The attribute data is followed by ATRAC3

music data. The music data is block-segmented every 16 KB. Each block starts with a header. The header contains an initial value for decrypting encrypted data. Only music data of an ATRAC3 data file is encrypted. Thus, other data such as the reproduction management file, the header, and so forth are not encrypted.

Next, with reference to Figs. 10A to 10C, the relation between music programs and ATRAC3 data files will be described. One track is equivalent to one music program. In addition, one music program is composed of one ATRAC3 data (see Fig. 9). The ATRAC3 data file is audio data that has been compressed corresponding to the ATRAC3 format. The ATRAC3 data file is recorded as a cluster at a time to the memory card 40. One cluster has a capacity of 16 KB. A plurality of files are not contained in one cluster. The minimum data erase unit of the flash memory 42 is one block. In the case of the memory card 40 for music data, a block is a synonym of a cluster. In addition, one cluster is equivalent to one sector.

One music program is basically composed of one part. However, when a music program is edited, one music program may be composed of a plurality of parts. A part is a unit of data that is successively recorded. Normally, one track is composed of one part. The connection of parts of a music program is managed with

part information PRTINF in the attribute header of each music program. In other words, the part size is represented with part size PRTSIZE (4 bytes) of the part information PRTINF. The first two bytes of the part size PRTSIZE represents the number of total clusters of the current part. The next two bytes represent the positions of the start sound unit (SU) and the end sound unit (SU) of the beginning and last clusters, respectively. Hereinafter, a sound unit is abbreviated as SU. With such a part notation, when music data is edited, the movement of the music data can be suppressed. When music data is edited for each block, although the movement thereof can be suppressed, the edit unit of a block is much larger than the edit unit of a SU.

SU is the minimum unit of a part. In addition, SU is the minimum data unit in the case that audio data is compressed corresponding to the ATRAC3 format. 1 SU is audio data of which data of 1024 samples at 44.1 kHz (1024 x 16 bits x 2 channels) is compressed to data that is around 10 times smaller than that of original data. The duration of 1 SU is around 23 msec. Normally, one part is composed of several thousand SU. When one cluster is composed of 42 SU, one cluster allows a sound of one second to be generated. The number of parts composing one track depends on the size of the additional information.

Since the number of parts is obtained by subtracting the header, the program name, the additional data, and so forth from one block, when there is no additional information, the maximum number of parts (645 parts) can be used.

Fig. 10A is a schematic diagram showing the file structure in the case that two music programs of a CD or the like are successively recorded. The first program (file 1) is composed of for example five clusters. Since one cluster cannot contain two files of the first program and the second program, the file 2 starts from the beginning of the next cluster. Thus, the end of the part 1 corresponding to the file 1 is in the middle of one cluster and the remaining area of the cluster contains no data. Likewise, the second music program (file 2) is composed of one part. In the case of the file 1, the part size is 5. The first cluster starts at 0-th SU. The last cluster ends at 4-th SU.

There are four types of edit processes that are a divide process, a combine process, an erase process, and a move process. The divide process is performed to divide one track into two portions. When the divide process is performed, the number of total tracks increases by one. In the divide process, one file is divided into two files on the file system. Thus, in this case, the reproduction management file and the FAT are updated. The combine process is

performed to combine two tracks into one track. When the combine process is performed, the number of total tracks decreases by one. In the combine process, two files are combined into one file on the file system. Thus, when the combine process is performed, the reproduction management file and the FAT are updated. The erase process is performed to erase a track. The track numbers after the track that has been erased decrease one by one. The move process is performed to change the track sequence. Thus, when the erase process or the move process is performed, the reproduction management file and the FAT are updated.

Fig. 10B is a schematic diagram showing the combined result of two programs (file 1 and file 2) shown in Fig. 10A. As a result of the combine process, the combined file is composed of two parts. Fig. 10C is a schematic diagram showing the divided result of which one program (file 1) is divided in the middle of the cluster 2. By the divide process, the file 1 is composed of clusters 0, 1, and the beginning portion of cluster 2. The file 2 is composed of the end portion of cluster 2 and clusters 3 and 4.

As described above, according to the embodiment of the present invention, since the part notation is defined, as the combined result (see Fig. 10B), the start position of the part 1, the end position of the part 1, and the end portion of the part

2 can be defined with SU. Thus, to pack the space due to the combined result, it is not necessary to move the music data of the part 2. In addition, as the divided result (see Fig. 10C), it is not necessary to move data and pack the space at the beginning of the file 2.

Fig. 11 is a schematic diagram showing the detailed data structure of the reproduction management file PBLIST. Figs. 12A and 12B show a header portion and the remaining portion of the reproduction management file PBLIST. The size of the reproduction management file is one cluster (one block = 16 KB). The size of the header shown in Fig. 12A is 32 bytes. The rest of the reproduction management file PBLIST shown in Fig. 12B contains a name NM1-S area (256 bytes) (for the memory card), a name NM2-S area (512 bytes), a contents key area, a MAC area, an S-YMDhms area, a reproduction sequence management table TRKTBL area (800 bytes), a memory card additional information INF-S area (14720 bytes), and a header information redundant area. The start positions of these areas are defined in the reproduction management file.

The first 32 bytes of (0x0000) to (0x0010) shown in Fig. 12A are used for the header. In the file, 16-byte areas are referred to as slots. Referring to Fig. 12A, the header are placed in the first and second slots. The header contains the following areas. An area denoted by "Reserved" is an

undefined area. Normally, in a reserved area, a null (0x00) is written. However, even if any data is written to a reserved area, the data written in the reserved is ignored. In a future version, some reserved areas may be used. In addition, data is prohibited from being written to a reserved area. When an option area is not used, it is treated as a reserved area.

= BLKID-TL0 (4 bytes)

Meaning: BLOCKID FILE ID

Function: Identifies the top of the reproduction management file.

Value: Fixed value = "TL = 0" (for example, 0x544C2D30)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player

Value: High-order 10 bits (Maker code); low-order 6 bits (model code).

= REVISION (4 bytes)

Meaning: Number of rewrite times of PBLIST

Function: Increments whenever the reproduction management file is rewritten.

Value: Starts at 0 and increments by 1.

= S-YMDhms (4 bytes) (Option)

Meaning: Year, month, day, hour, minute, and

second recorded by the recorder/player with a reliable clock.

Function: Identifies the last recorded date and time.

Value: bits 25 to 31: Year 0 to 99 (1980 to 2079)

bits 21 to 24: Month 0 to 12

bits 16 to 20: Day 0 to 31

bits 11 to 15: Hour 0 to 23

bits 05 to 10: Minute 0 to 59

bits 00 to 04: Second 0 to 29 (two bit interval)

= SY1C+L (2 bytes)

Meaning: Attribute of name (one byte code) of memory card written in NM1-S area.

Function: Represents the character code and the language code as one byte code.

Value: Character code (C): High-order one byte

00: Non-character code, binary number

01: ASCII (American Standard Code for Information Interchange)

02: ASCII+KANA

03: Modified 8859-1

81: MS-JIS

82: KS C 5601-1989

83: GB (Great Britain) 2312-80

90: S-JIS (Japanese Industrial Standards) (for Voice)

Language code (L): Low-order one byte

Identifies the language based on EBU Tech 3258 standard.

00: Not set

08: German

09: English

0A: Spanish

0F: French

15: Italian

1D: Dutch

65: Korean

69: Japanese

75: Chinese

When data is not recorded, this area is all 0.

= SN2C+L (2 bytes)

Meaning: Attribute of name of memory card in NM2-S area.

Function: Represents the character code and the language coded as one byte code.

Value: Same as SN1C+L

= SINFSIZE (2 bytes)

Meaning: Total size of additional

information of memory card in INF-S area.

Function: Represents the data size as an increment of 16 bytes. When data is not recorded, this area is all 0.

Value: Size: 0x0001 to 0x39C (924)

= T-TRK (2 bytes)

Meaning: TOTAL TRACK NUMBER

Function: Represents the number of total tracks.

Value: 1 to 0x0190 (Max. 400 tracks)

When data is recorded, this area is all 0.

= VerNo (2 bytes)

Meaning: Format version number

Function: Represents the major version number (high order one byte) and the minor version number (low order one byte).

Value: 0x0100 (Ver 1.0)

0x0203 (Ver 2.3)

Next, areas (see Fig. 13B) that preceded by the header will be described.

= NM1-S

Meaning: Name of memory card (as one byte code)

Function: Represents the name of the memory card as one byte code (max. 256). At the end of this area, an end code (0x00) is written. The size is

calculated from the end code. When data is not recorded, null (0x00) is recorded from the beginning (0x0020) of this area for at least one byte.

Value: Various character code

= NM2-S

Meaning: Name of memory card (as two byte code)

Function: Represents the name of the memory card as two byte code (max. 512). At the end of this area, an end code (0x00) is written. The size is calculated from the end code. When data is not recorded, null (0x00) is recorded from the beginning (0x0120) of this area for at least two bytes.

Value: Various character code

= CONTENTS KEY

Meaning: Value for music program. Protected with MG(M) and stored. Same as CONTENTS KEY.

Function: Used as a key necessary for calculating MAC of S-YMDhms.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= MAC

Meaning: Forged copyright information check value

Function: Represents the value generated with S-YMDhms and CONTENTS KEY.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= TRK-nnn

Meaning: SQN (sequence) number of ATRAC3 data file reproduced.

Function: Represents FNo of TRKINF.

Value: 1 to 400 (0x190)

When there is no track, this area is all 0.

= INF-S

Meaning: Additional information of memory card (for example, information with respect to photos, songs, guides, etc.)

Function: Represents variable length additional information with a header. A plurality of types of additional information may be used. Each of the types of additional information has an ID and a data size. Each additional information area including a header is composed of at least 16 bytes and a multiple of 4 bytes. For details, see the following section.

Value: Refer to the section of "Data Structure of Additional Information".

= S-YMDhms (4 bytes) (Option)

Meaning: Year, month, day, hour, minute, and second recorded by the recorder/player with a reliable clock.

Function: Identifies the last recorded date and time. In this case of EMD, this area is mandatory.

Value: bits 25 to 31: Year 0 to 99 (1980 to

2079)

bits 21 to 24: Month 0 to 12

bits 16 to 24: Day 0 to 31

bits 11 to 15: Hour 0 to 23

bits 05 to 10: Minute 0 to 59

bits 00 to 04: Second 0 to 29 (two second interval)

As the last slot of the reproduction management file, the same BLKID-TL0, MCode, and REVISION as those in the header are written.

While data is being recorded to a memory card, it may be mistakenly or accidentally detached or the power of the recorder/player may be turned off. When such an improper operation is performed, a defect should be detected. As described above, the REVISION area is placed at the beginning and end of each block. Whenever data is rewritten, the value of the REVISION area is incremented. If a defect termination takes place in the middle of a block, the value of the REVISION area at the beginning of the block does not match the value of the REVISION area at the end of the block. Thus, such a defect termination can be detected. Since there are two REVISION areas, the abnormal termination can be detected with a high probability. When an abnormal termination is detected, an alarm such as an error message is generated.

In addition, since the fixed value BLKID-TL0

is written at the beginning of one block (16 KB), when the FAT is destroyed, the fixed value is used as a reference for recovering data. In other words, with reference to the fixed value, the type of the file can be determined. Since the fixed value BLKID-TL0 is redundantly written at the header and the end portion of each block, the reliability can be secured. Alternatively, the same reproduction management file can be redundantly recorded.

The data amount of an ATRAC3 data file is much larger than that of the track information management file. In addition, as will be described later, a block number BLOCK SERIAL is added to ATRAC3 data file. However, since a plurality of ATRAC3 files are recorded to the memory card, to prevent them from become redundant, both CONNUM0 and BLOCK SERIAL are used. Otherwise, when the FAT is destroyed, it will be difficult to recover the file. In other words, one ATRAC3 data file may be composed of a plurality of blocks that are dispersed. To identify blocks of the same file, CONNUM0 is used. In addition, to identify the order of blocks in the ATRAC3 data file, BLOCK SERIAL is used.

Likewise, the maker code (Mcode) is redundantly recorded at the beginning and the end of each block so as to identify the maker and the model in such a case that a file has been improperly recorded in

the state that the FAT has not been destroyed.

Fig. 12C is a schematic diagram showing the structure of the additional information data. The additional information is composed of the following header and variable length data. The header has the following areas.

= INF

Meaning: FIELD ID

Function: Represents the beginning of the additional information (fixed value).

Value: 0x69

= ID

Meaning: Additional information key code

Function: Represents the category of the additional information.

Value: 0 to 0xFF

= SIZE

Meaning: Size of individual additional information

Function: Represents the size of each type of additional information. Although the data size is not limited, it should be at least 16 bytes and a multiple of 4 bytes. The rest of the data should be filled with null (0x00).

Value: 16 to 14784 (0x39C0)

= MCode

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player.

Value: High-order 10 bits (maker code), low-order 10 bits (machine code).

= C+L

Meaning: Attribute of characters in data area starting from byte 12.

Function: Represents the character code and the language code as one byte code.

Value: Same as SNC+L

= DATA

Meaning: Individual additional information

Function: Represents each type of additional information with variable length data. Real data always starts from byte 12. The length (size) of the real data should be at least 4 bytes and a multiple of 4 bytes. The rest of the data area should be filled with null (0x00).

Value: Individually defined corresponding to the contents of each type of additional information.

Fig. 13 is a table that correlates key code values (0 to 63 of additional information and types thereof. Key code values (0 to 31) are assigned to music character information. Key code values (32 to 63) are assigned to URLs (Uniform Resource Locator) (web information). The music character information and URL information contain character information of the

album title, the artist name, the CM, and so forth as additional information.

Fig. 14 is a table that correlates key code values (64 to 127) of additional information and types thereof. Key code values (64 to 95) are assigned to paths/others. Key code values (96 to 127) are assigned to control/numeric data. For example, ID = 98 represents TOC-ID as additional information. TOC-ID represents the first music program number, the last music program number, the current program number, the total performance duration, and the current music program duration corresponding to the TOC information of a CD (Compact Disc).

Fig. 15 is a table that correlates key code values (128 to 159) of additional information and types thereof. Key code values (128 to 159) are assigned to synchronous reproduction information. In Fig. 15, EMD stands for electronic music distribution.

Next, with reference to Figs. 16A to 16E, real examples of additional information will be described. As with Fig. 12C, Fig. 16A shows the data structure of the additional information. In Fig. 16B, key code ID = 3 (artist name as additional information). SIZE = 0x1C (28 bytes) representing that the data length of additional information including the header is 28 bytes; C+L representing that character code C = 0x01 (ASCII) and language code L = 0x09

(English). Variable length data after byte 12 represents one byte data "SIMON & GRAFUNKEL" as artist name. Since the data length of the additional information should be a multiple of 4 bytes, the rest is filled with (0x00).

In Fig. 16C, key code ID = 97 representing that ISRC (International Standard Recording Code: Copyright code) as additional information. SIZE = 0x14 (20 bytes) representing that the data length of the additional information is 20 bytes. C = 0x00 and L = 0x00 representing that characters and language have not been set. Thus, the data is binary code. The variable length data is eight-byte ISRC code representing copyright information (nation, copyright owner, recorded year, and serial number).

In Fig. 16D, key code ID =is 97 representing recorded date and time as additional information. SIZE = 0 x 10 (16 bytes) representing that the data length of the additional information is 16 bytes. C = 0x00 and L = representing that characters and language have not been set. The variable length data is four-byte code (32 bit) representing the recorded date and time (year, month, day, hour, minute, second).

In Fig. 16E, key code ID = 107 representing a reproduction log as additional information. SIZE = 0x10 (16 bytes) representing that the data length of the additional information is 16 bytes. C = 0x00 and L

= 0x00 representing that characters and language have not been set. The variable length data is a four-byte code representing a reproduction log (year, month, day, hour, minute, second). When the recorder/player has a reproduction log function, it records data of 16 bytes whenever it reproduces music data.

Fig. 17 is a schematic diagram showing a data arrangement of ATRAC3 data file A3Dnnnn in the case that 1 SU is N bytes (for example, N = 384 bytes). Fig. 17 shows an attribute header (1 block) of a data file and a music data file (1 block). Fig. 17 shows the first byte (0x0000 to 0x7FF0) of each slot of the two blocks (16 x 2 = 32 kbytes). As shown in Fig. 18, the first 32 bytes of the attribute header are used as a header; 256 bytes are used as a music program area NM1 (256 bytes); and 512 bytes are used as a music program title area NM2 (512 bytes). The header of the attribute header contains the following areas.

= BLKID-HD0 (4 bytes)

Meaning: BLOCKID FIELD ID

Function: Identifies the top of an ATRA3 data file.

Value: Fixed value = "HD = 0" (For example, 0x48442D30)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of

the recorder/player

Value: High-order 10 bits (maker code); low-order 6 bits (machine code)

= BLOCK SERIAL (4 bytes)

Meaning: Track serial number

Function: Starets from 0 and increments by 1. Even if a music program is edited, this value does not vary.

Value: 0 to 0xFFFFFFFF.

= N1C+L (2 bytes)

Meaning: Represents the attribute of data (NM1) of a track (music program title).

Function: Represent the character code and language code of NM1 as one byte code.

Value: Same as SN1C+L

= N2C+L (2 bytes)

Meaning: Represents the attribute of data (NM2) of a track (music program title).

Function: Represent the character code and language code of NM1 as one byte code.

Value: Same as SN1C+L

= INFSIZE (2 bytes)

Meaning: Total size of additional information of current track.

Function: Represents the data size as a multiple of 16 bytes. When data is not recorded, this area should be all 0.

Value: 0x0000 to 0x3C6 (966)

= T-PRT (2 bytes)

Meaning: Number of total bytes

Function: Represents the number of parts that composes the current track. Normally, the value of T-PRT is 1.

Value: 1 to 285 (645 dec).

= T-SU (4 bytes)

Meaning: Number of total SU.

Function: Represents the total number of SU in one track that is equivalent to the program performance duration.

Value: 0x01 to 0x001FFFFF

= INX (2 bytes) (Option)

Meaning: Relative position of INDEX

Function: Used as a pointer that represents the top of a representative portion of a music program. The value of INX is designated with a value of which the number of SU is divided by 4 as the current position of the program. This value of INX is equivalent to 4 times larger than the number of SU (around 93 msec).

Value: 0 to 0xFFFF (max, around 6084 sec)

= XT (2 bytes) (Option)

Meaning: Reproduction duration of INDEX

Function: Designates the reproduction duration designated by INX-nnn with a value of which

the number of SU is divided by 4. The value of INDEX is equivalent to four times larger than the normal SU (around 93 msec).

Value: 0x0000 (no setting); 0x01 to 0xFFFE (up to 6084 sec); 0xFFFF (up to end of music program)

Next, the music program title areas NM1 and NM2 will be described.

= NM1

Means: Character string of music program title

Function: Represents a music program title as one byte code (up to 256 characters) (variable length). The title area should be completed with an end code (0x00). The size should be calculated from the end code. When data is not recorded, null (0x00) should be recorded from the beginning (0x0020) of the area for at least one byte.

Value: Various character codes

= NM2

Means: Character string of music program title

Function: Represents a music program title as two byte code (up to 512 characters) (variable length). The title area should be completed with an end code (0x00). The size should be calculated from the end code. When data is not recorded, null (0x100) should be recorded from the beginning (0x0120) of the

area for at least two bytes.

Value: Various character codes

Data of 80 bytes starting from the fixed position (0x320) of the attribute header is referred to as track information area TRKINF. This area is mainly used to totally manage the security information and copy control information. Fig. 19 shows a part of TRKINF. The area TRKINF contains the following areas.

= CONTENTS KEY (8 bytes)

Meaning: Value for each music program. The value of CONTENTS KEY is protected in the security block of the memory card and then stored.

Function: Used as a key for reproducing a music program. It is used to calculate the value of MAC.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= MAC (8 bytes)

Meaning: Forged copyright information check value Function: Represents the value generated with a plurality of values of TRKINF including contents cumulation numbers and a secret sequence number.

The secret sequence number is a sequence number recorded in the secret area of the memory card. A non-copyright protection type recorder cannot read data from the secret area of the memory card. On the other hand, a copyright protection type recorder and a computer that operates with a program that can read

data from a memory card can access the secret area.

= A (1 byte)

Meaning: Attribute of part.

Function: Represents the information of such as compression mode of a part.

Value: The details will be described in the following (see Figs. 19 and 20).

Next, the value of the area A will be described. In the following description, monaural mode (N = 0 or 1) is defined as a special joint mode of which bit 7 = 1, sub signal = 0, main signal = (L+R). A non-copyright protection type player may ignore information of bits 2 and 1.

Bit 0 of the area A represents information of emphasis on/off state. Bit 1 of the area A represents information of reproduction skip or normal reproduction. Bit 2 of the area A represents information of data type such as audio data, FAX data, or the like. Bit 3 of the area A is undefined. By a combination of bits 4, 5, and 6, mode information of ATRAC3 is defined as shown in Fig. 20. In other words, N is a mode value of 3 bits. For five types of modes that are monaural (N = 0 or 1), LP (N = 2), SP (N = 4), EX (N = 5), and HQ (N = 7), record duration (64 MB memory card only), data transmission rate, and the number of SU per block are listed. The number of bytes of 1 SU depends on each mode. The number of bytes of 1

SU in the monaural mode is 136 bytes. The number of bytes of 1 SU in the LP mode is 192 bytes. The number of bytes of 1 SU in the SP mode is 304 bytes. The number of bytes of 1 SU in the EX mode is 384 bytes. The number of bytes of 1 SU in the HQ mode is 512 bytes. Bit 7 of the area A represents ATRAC3 modes (0: Dual, 1: JOint).

For example, an example of which a 64 MB memory card is used in the SP mode will be described. A 64-MB memory card has 3968 blocks. In the SP mode, since 1 SU is 304 bytes, one block has 53 SU. 1 SU is equivalent to (1024/44100) seconds. Thus, one block is (1024/44100) x 53 x (3968 - 10) = 4863 seconds = 81 minutes. The transmission rate is (44100/1024) x 304 x 8 = 104737 bps.

= LT (one byte)

Meaning: Reproduction restriction flag (bits 7 and 6) and security partition (bits 5 to 0).

Function: Represents a restriction of the current track.

Value: bit 7: 0 = no restriction, 1 = restriction

bit 6: 0 = not expired, 1 = expired

bits 5 to 0: security partition (reproduction prohibited other than 0)

= FNo (2 bytes)

Meaning: File number.

Function: Represents the initially recorded track number that designates the position of the MAC calculation value recorded in the secret area of the memory card.

Value: 1 to 0x190 (400)

= MG(D) SERIAL-nnn (16 bytes)

Meaning: Represents the serial number of the security block (security IC 20) of the recorder/player.

Function: Unique value for each recorder/player

Value: 0 to 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

= CONNUM (4 bytes)

Meaning: Contents cumulation number

Function: Represents a unique value cumulated for each music program. The value is managed by the security block of the recorder/player. The upper limit of the value is 2^{32} that is 4,200,000,000. Used to identify a recorded program.

Value: 0 to 0xFFFFFFFF

YMDhms-S (4 bytes) (Option)

Meaning: Reproduction start date and time of track with reproduction restriction

Function: Represents the date and time at which data reproduction is permitted with EMD.

Value: Same as the notation of date and time

of other areas

= YMDhms-E (4 bytes) (Option)

Meaning: Reproduction end date and time of track with reproduction restriction

Function: Represents the date and time at which data reproduction is expired with EMD.

Value: Same as the notation of date and time of other areas

= MT (1 byte) (Option)

Meaning: Maximum value of number of permitted reproduction times

Function: Represents the maximum number of reproduction times designated by EMD.

Value: 1 to 0xFF. When not used, the value of the area MT is 00.

= CT (1 byte) (Option)

Meaning: Number of reproduction times

Function: Represents the number of reproduction times in the number of permitted reproduction times. Whenever data is reproduced, the value of the area CT is decremented.

Value: 0x00 to 0xFF. When not used, the value of the area CT is 0x00. When bit 7 of the area LT is 1 and the value of the area CT is 00, data is prohibited from being reproduced.

= CC (1 byte)

Meaning: COPY CONTROL

Function: Controls the copy operation.

Value: bits 6 and 7 represent copy control information. bits 4 and 5 represent copy control information of a high speed digital copy operation. bits 2 and 3 represent a security block authentication level. bits 0 and 1 are undefined.

Example of CC:

(bits 7 and 6)

11: Unlimited copy operation permitted

01: copy prohibited

00: one time copy operation permitted

(bits 3 and 2)

00: analog/digital input recording

MG authentication level is 0.

When digital record operation using data from a CD is performed, (bits 7 and 6): 00 and (bits 3 and 2): 00.

= CN (1 byte) (Option)

Meaning: Number of permitted copy times in high speed serial copy management system

Function: Extends the copy permission with the number of copy times, not limited to one time copy permission and copy free permission. Valid only in first copy generation. The value of the area CN is decremented whenever the copy operation is performed.

Value"

00: Copy prohibited

01 to 0xFE: Number of times

0xFF: Unlimited copy times

The track information area TRKINF is followed by a 24-byte part management information area (PRTINF) starting from 0x0370. When one track is composed of a plurality of parts, the values of areas PRTINF of the individual parts are successively arranged on the time axis. Fig. 22 shows a part of the area PRTINF. Next, areas in the area PRTINF will be described in the order of the arrangement.

= PRTSIZE (4 bytes)

Meaning: Part size

Function: Represents the size of a part. Cluster: 2 bytes (highest position), start SU: 1 byte (upper), end SU: 1 byte (lowest position).

Value: cluster: 1 to 0x1F40 (8000)

start SU: 0 to 0xA0 (160)

end SU: 0 to 0xA0 (16) (Note that SU starts from 0.)

= PRTKEY (8 bytes)

Meaning: Part encrypting value

Function: Encrypts a part. Initial value = 0. Note that edit rules should be applied.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= CONNUM0 (4 bytes)

Meaning: Initially generated contents cumulation number key

Function: Uniquely designates an ID of contents.

Value: Same value as the value of the contents cumulation number initial value key

As shown in Fig. 17, the attribute header of an ATRAC3 data file contains additional information INF. The additional information is the same as the additional information INF-S (see Figs. 11 and 12B) of the reproduction management file except that the start position is not fixed. The last byte position (a multiple of four bytes) at the end of one or a plurality of parts is followed by data of the additional information INF.

= INF

Meaning: Additional information with respect to track

Function: Represents variable length additional information with a header. A plurality of different types of additional information may be arranged. Each of additional information areas has an ID and a data size. Each additional information area is composed of at least 16 bytes and a multiple of 4 bytes.

Value: Same as additional information INF-S of reproduction management file

The above-described attribute header is followed by data of each block of an ATRAC3 data file.

As shown in Fig. 23, a header is added for each block. Next, data of each block will be described.

= BLKID-A3D (4 bytes)

Meaning: BLOCKID FILE ID

Function: Identifies the top of ATRAC3 data.

Value: Fixed value = "A3D" (for example, 0x41334420)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player

Value: High-order 10 bits (maker code); low-order 6 bits (model code)

= CONNUMO (4 bytes)

Meaning: Cumulated number of initially created contents

Function: Designates a unique ID for contents. Even if the contents are edited, the value of the area CONNUMO is not changed.

Value: Same as the contents cumulation number initial key

= BLOCK SERIAL (4 bytes)

Meaning: Serial number assigned to each track

Function: Starts from 0 and increments by 1. Even if the contents are edited, the value of the area BLOCK SERIAL is not changed.

Value: 0 to 0xFFFFFFFF

= BLOCK-SEED (8 bytes)

Meaning: Key for encrypting one block

Function: The beginning of the block is a random number generated by the security block of the recorder/player. The random number is followed by a value incremented by 1. When the value of the area BLOCK-SEED is lost, since sound is not generated for around one second equivalent to one block, the same data is written to the header and the end of the block. Even if the contents are edited, the value of the area BLOCK-SEED is not changed.

Value: Initially 8-bit random number

= INITIALIZATION VECTOR (8 bytes)

Meaning: Value necessary for encrypting/decrypting ATRAC3 data

Function: Represents an initial value necessary for encrypting and decrypting ATRAC3 data for each block. A block starts from 0. The next block starts from the last encrypted 8-bit value at the last SU. When a block is divided, the last eight bytes just before the start SU is used. Even if the contents are edited, the value of the area INITIALIZATION VECTOR is not changed.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= SU-nnn

Meaning: Data of sound unit

Function: Represents data compressed from 1024 samples. The number of bytes of output data depends on the compression mode. Even if the contents are edited, the value of the area SU-nnn is not changed. For example, in the SP mode, N = 384 bytes.

Value: Data value of ATRAC3

In Fig. 17, since N = 384, 42 SU are written to one block. The first two slots (4 bytes) of one block are used as a header. In the last slot (two bytes), the areas BLKID-A3D, MCode, CONNUM0, and BLOCK SERIAL are redundantly written. Thus, M bytes of the remaining area of one block is (16,384 - 384 x 42 - 16 x 3 = 208) bytes. As described above, the eight-byte area BLOCK SEED is redundantly recorded.

When the FAT area is destroyed, all blocks of the flash memory are searched. It is determined whether the value of the area ID BLKID at the beginning of each block is TL0, HD0, or A3D. As shown in Figs. 24A to 24C, at step SP1, it is determined whether or not the value of the area ID BLKID at the beginning of the top block is BLKID-TL0. When the determined result at step SP1 is No, the flow advances to step SP2. At step SP2, the block number is incremented. Thereafter, at step SP3, it is determined whether or not the last block has been searched.

When the determined result at step SP3 is No, the flow returns to step SP1.

When the determined result at step SP1 is Yes, the flow advances to step SP4. At step SP4, it is determined that the searched block is the reproduction management file PBLIST. Thereafter, the flow advances to step SP5. At step SP5, the number of total tracks T-TRK in the reproduction management file PBLIST is stored as N to the register. For example, when the memory has stored 10 ATRAC3 data files (10 music programs), 10 has been stored in T-TRK.

Next, with reference to the value of the number of total tracks T-TRK, TRK-001 to TRK-400 of blocks are successively referenced. In this example, since 10 music programs have been recorded, TRK-001 to TRK-010 of blocks are referenced. Since a file number FNO has been recorded in TRK-XXX (where X = 1 to 400) at step SP7, a table that correlates the track number TRK-XXX and the file number FNO is stored to the memory. Next, at step SP8, N stored in the register is decremented. A loop of steps SP6, SP7, and SP8 is repeated until N becomes 0 at step SP9.

When the determined result at step SP9 is Yes, the flow advances to step SP10. At step SP10, the pointer is reset to the top block. The searching process is repeated from the top block. Thereafter, the flow advances to step SP11. At step SP11, it is determined whether or not the value of the area ID BLKID of the top block is BLKID-HD0. When the

determined result at step SP11 is No, the flow advances to step SP12. At step SP12, the block number is incremented. At step SP13, it is determined whether or not the last block has been searched.

When the determined result at step SP13 is No, the flow returns to step SP11. The searching process is repeated until the determined result at step SP11 becomes Yes.

When the determined result at step SP11 is Yes, the flow advances to step SP14. At step SP14, it is determined that the block is the attribute header (see Fig. 8) (0x0000 to 0x03FFF shown in Fig. 18) at the beginning of the ATRAC3 data file.

Next, at step SP15, with reference to the file number FNO, the sequence number BLOCK SERIAL of the same ATRAC data file, and the contents cumulation number key CONNUM0 contained in the attribute header, they are stored to the memory. When 10 ATRAC3 data files have been recorded, since there are 10 blocks of which the value of the area ID BLKID of the top block is BLKID-TL0, the searching process is continued until 10 blocks are searched.

When the determined result at step SP13 is Yes, the flow advances to step SP16. At step SP16, the pointer is reset to the top block. The searching process is repeated from the top block.

Thereafter, the flow advances to step SP17.

At step SP17, it is determined whether or not the value of the area ID BLKID of the top block is BLKID-A3D.

When the determined result at step SP17 is No, the flow advances to step SP18. At step SP18, the block number is incremented. Thereafter, at step SP18', it is determined whether or not the last block has been searched. When the determined result at step SP18' is No, the flow returns to step SP17.

When the determined result at step SP17 is Yes, the flow advances to step SP19. At step SP19, it is determined that the block contains ATRAC3 data. Thereafter, the flow advances to step SP20. At step SP20, with reference to the serial number BLOCK SERIAL recorded in the ATRAC3 data block and the contents cumulation number key CONNUM0, they are stored to the memory.

In the same ATRAC3 data file, the common number is assigned as the contents cumulation number key CONNUM0. In other words, when one ATRAC3 data file is composed of 10 blocks, a common number is assigned to all the values of the areas CONNUM0.

In addition, when one ATRAC3 data is composed of 10 blocks, serial numbers 1 to 0 are assigned to the values of the areas BLOCK SERIALs of the 10 blocks.

Corresponding to the values of the areas CONNUM0 and BLOCK SERIAL, it is determined whether the current block composes the same contents and the

reproduction order of the current block in the same contents (namely, the connection sequence).

When 10 ATRAC3 data files (namely, 10 music programs) have been recorded and each of the ATRAC3 data files is composed of 10 blocks, there are 100 data blocks.

With reference to the values of the areas CONNUM0 and BLOCK SERIAL, the reproduction order of music programs of 100 data blocks and the connection order thereof can be obtained.

When the determined result at step SP19 is Yes, all the blocks have been searched for the reproduction management file, the ATRAC3 data file, and the attribute file. Thus, at step SP21, based on the values of the areas CONNUM0, BLOCK SERIAL, FNO, and TRK-X in the order of block numbers of the blocks stored in the memory, the file connection state is obtained.

After the connection state is obtained, the FAT may be generated in a free area of the memory.

Next, a management file according to a second embodiment of the present invention will be described. Fig. 25 shows the file structure according to the second embodiment of the present invention. Referring to Fig. 25, a music directory contains a track information management file TRKLIST.MSF (hereinafter, referred to as TRKLIST), a backup track information

management file TRKLISTB.MSF (hereinafter, referred to as TRKLISTB), an additional information file INFLIST.MSF (that contains an artist name, an ISRC code, a time stamp, a still picture data, and so forth (this file is referred to as INFIST)), an ATRAC3 data file A3Dnnnn.MSF (hereinafter, referred to as A3nnnn). The file TRKLIST contains two areas NAME1 and NAME2. The area NAME1 is an area that contains the memory card name and the program name (for one byte code corresponding to ASCII/8859-1 character code). The area NAME2 is an area that contains the memory card name and the program name (for two byte code corresponding to MS-JIS/Hankul/Chinese code).

Fig. 26 shows the relation between the track information management file TRKLIST, the areas NAME1 and NAME2, and the ATRAC3 data file A3Dnnnn. The file TRKLIST is a fixed-length file of 64 kbytes (= 16 k x 4). An area of 32 kbytes of the file is used for managing tracks. The remaining area of 32 kbytes is used to contain the areas NAME1 and NAME2. Although the areas NAME1 and NAME2 for program names may be provided as a different file as the track information management file, in a system having a small storage capacity, it is convenient to totally manage the track information management file and program name files.

The track information area TRKINF-nnnn and part information area PRTINF-nnnn of the track

information management file TRKLIST are used to manage the data file A3Dnnnn and the additional information INFLIST. Only the ATRAC3 data file A3Dnnnn is encrypted. In Fig. 26, the data length in the horizontal direction is 16 bytes (0 to F). A hexadecimal number in the vertical direction represents the value at the beginning of the current line.

According to the second embodiment, three files that are the track management file TRKLIST (including a program title file), the additional information management file INFLIST, and the data file A3Dnnnn are used. According to the first embodiment (see Figs. 7, 8, and 9), two files that are the reproduction management file PBLIST for managing all the memory card and the data file ATRAC3 for storing programs are used.

Next, the data structure according to the second embodiment will be described. For simplicity, in the data structure according to the second embodiment, the description of similar portions to those of the first embodiment is omitted.

Fig. 27 shows the detailed structure of the track information management file TRKLIST. In the track information management file TRKLIST, one cluster (block) is composed of 16 kbytes. The size and data of the file TRKLISTB are the same as those of the backup file TRKLISTB. The first 32 bytes of the track

information management file are used as a header. As with the header of the reproduction management file PBLIST, the header of the file TRKLIST contains a BLKID-TL0/TL1 (backup file ID) area (4 bytes), an area T-TRK (2 bytes) for the number of total tracks, a maker code area MCode (2 bytes), an area REVISION (4 bytes) for the number of TRKLIST rewrite times, and an area S-YMDhms (4 bytes) (option) for update date and time data. The meanings and functions of these data areas are the same as those of the first embodiment. In addition, the file TRKLIST contains the following areas.

= YMDhms (4 bytes)

Represents the last update date (year, month, day) of the file TRKLIST.

= N1 (1 byte) (Option)

Represents the sequential number of the memory card (numerator side). When one memory card is used, the value of the area N1 is 0x01.

= N2 (1 byte) (Option)

Represents the sequential number of the memory card (denominator side). When one memory card is used, the value of the area N2 is 0x01.

= MSID (2 bytes) (Option)

Represents the ID of a memory card. When a plurality of memory cards is used, the value of the area MSID of each memory card is the same (T.B.D.).

(T.B.D. (to be defined) represents that this value may be defined in future).

= S-TRK (2 bytes).

Represents a special track (T.B.D.). Normally, the value of the area S-TRK is 0x0000.

= PASS (2 bytes) (Option)

Represents a password (T.B.D.).

= APP (2 bytes) (Option)

Represents the definition of a reproduction application (T.B.D.) (normally, the value of the area APP is 0x0000).

= INF-S (2 bytes) (Option)

Represents the additional information pointer of the entire memory card. When there is no additional information, the value of the area INF-S is 0x00.

The last 16 bytes of the file TRKLIST are used for an area BLKID-TL0, an area MCode, and an area REVISION that are the same as those of the header. The backup file TRKLISTB contains the above-described header. In this case, the header contains an area BLKID-TL1, an area MCode, and an area REVISION.

The header is followed by a track information area TRKINF for information with respect to each track and a part information area PRTINF for information with respect to each part of tracks (music programs). Fig. 27 shows the areas preceded by the area TRKLIST. The lower portion of the area TRKLISTB shows the detailed

structure of these areas. In Fig. 27, a hatched area represents an unused area.

The track information area TRKINF-nnn and the part information area PRTINF-nnn contain areas of an ATRAC3 data file. In other words, the track information area TRKINF-nnn and the part information area PRTINF-nnn each contain a reproduction restriction flag area LT (1 byte), a contents key area CONTENTS KEY (8 bytes), a recorder/player security block serial number area MG(D) SERIAL (16 bytes), an area XT (2 bytes) (option) for representing a feature portion of a music program, an area INX (2 bytes) (option), an area YMDhms-S (4 bytes) (option), an area YMDhms-E (4 bytes) (option), an area MT (1 byte) (option), an area CT (1 byte) (option), an area CC (1 byte) (option), an area CN (1 byte) (option) (these areas YMDhms-S, YMDhms-E, MT, CT, CC, and CN are used for reproduction restriction information and copy control information), an area A (1 byte) for part attribute, a part size area PRTSIZE (4 bytes), a part key area PRTKEY (8 bytes), and a contents cumulation number area CONNUM (4 bytes). The meanings, functions, and values of these areas are the same as those of the first embodiment. In addition, the track information area TRKINF-nnn and the part information area PRTINF-nnn each contain the following areas.

= T0 (1 byte)

Fixed value (T0 = 0x74)

= INF-nnn (Option) (2 bytes)

Represents the additional information pointer (0 to 409) of each track. 00: music program without additional information.

= FNM-nnn (4 bytes)

Represents the file number (0x0000 to 0xFFFF) of an ATRK3 data file.

The number nnnn (in ASCII) of the ATRAC3 data file name (A3Dnnnn) is converted into 0xnnnnn.

= APP_CTL (4 bytes) (Option)

Represents an application parameter (T.B.D.) (Normally, the value of the area APP_CTL is 0x0000).

= P-nnn (2 bytes)

Represents the number of parts (1 to 2039) that compose a music program. This area corresponds to the above-described area T-PART.

= PR (1 byte)

Fixed value (PR = 0 x 50).

Next, the areas NAME1 (for one byte code) and NAME2 (for two byte code) for managing names will be described. Fig. 28 shows the detailed structure of the area NAME1 (for one byte code area). Each of the areas NAME1 and NAME2 (that will be described later) is segmented with eight bytes. Thus, their one slot is composed of eight bytes. At 0x8000 that is the beginning of each of these areas, a header is placed.

The header is followed by a pointer and a name. The last slot of the area NAME1 contains the same areas as the header.

= BLKID-NM1 (4 bytes)

Represents the contents of a block (fixed value) (NM1 = 0x4E4D2D31).

= PNM1-nnn (4 bytes) (Option)

Represents the pointer to the area NM1 (for one byte code).

= PNM1-S

Represents the pointer to a name representing a memory card.

nnn (= 1 to 408) represents the pointer to a music program title.

The pointer represents the start position (2 bytes) of the block, the character code type (2 bits), and the data size (14 bits).

= NM1-nnn (Option)

Represents the memory card name and music program title for one byte code (variable length). An end code (0x00) is written at the end of the area.

Fig. 29 shows the detailed data structure of the area NAME2 (for two byte code). At 0x8000 that is the beginning of the area, a header is placed. The header is followed by a pointer and a name. The last slot of the area NAME2 contains the same areas as the header.

= BLKID-NM2 (4 bytes)

Represents the contents of a block (fixed value) (NM2 = 0x4E4D2D32).

= PNM2-nnn (4 bytes) (Option)

Represents the pointer to the area NM2 (for two byte code).

PNM2-S represents the pointer to the name representing the memory card. nnn (= 1 to 408) represents the pointer to a music program title.

The pointer represents the start position (2 bytes) of the block, the character code type (2 bits), and the data size (14 bits).

= NM2-nnn (Option)

Represents the memory card name and music program title for two byte code (variable). An end code (0x0000) is written at the end of the area.

Fig. 30 shows the data arrangement (for one block) of the ATRAC3 data file A3Dnnnn in the case that 1 SU is composed of N bytes. In this file, one slot is composed of eight bytes. Fig. 30 shows the values of the top portion (0x0000 to 0x3FF8) of each slot. The first four slots of the file are used for a header. As with the data block preceded by the attribute header of the data file (see Fig. 17) of the first example, a header is placed. The header contains an area BLKID-A3D (4 bytes), a maker code area MCode (2 bytes), an area BLOCK SEED (8 bytes) necessary for encrypting

process, an area CONNUM0 (4 bytes) for the initial contents cumulation number, a serial number area BLOCK SERIAL (4 bytes) for each track, and an area INITIALIZATION VECTOR (8 bytes) necessary for encrypting/decrypting process. The second last slot of the block redundantly contains an area BLOCK SEED. The last slot contains areas BLKID-A3D and MCode. As with the first embodiment, the header is followed by the sound unit data SU-nnnn.

Fig. 31 shows the detailed data structure of the additional information management file INFLIST that contains additional information. In the second embodiment, at the beginning (0x0000) of the file INFLIST, the following header is placed. The header is followed by the following pointer and areas.

= BLKID-INF (4 bytes)

Represents the contents of the block (fixed value) (INF = 0x494E464F).

= T-DAT (2 blocks)

Represents the number of total data areas (0 to 409).

= MCode (2 bytes)

Represents the maker code of the recorder/player

= YMDhms (4 bytes)

Represents the record updated date and time.

= INF-nnnn (4 bytes)

Represents the pointer to the area DATA of the additional information (variable length, as 2 bytes (slot) at a time). The start position is represented with the high order 16 bits (0000 to FFFF).

= DataSlot-0000 (0x0800)

Represents the offset value from the beginning (as a slot at a time).

The data size is represented with low order 16 bits (0001 to 7FFF). A disable flag is set at the most significant bit. MSB = 0 (Enable), MSB = 1 (Disable)

The data size represents the total data amount of the music program.

(The data starts from the beginning of each slot. (The non-data area of the slot is filled with 00.)

The first INF represents a pointer to additional information of the entire album (normally, INF-409).

Fig. 32 shows the structure of additional information. An 8-byte header is placed at the beginning of one additional information data area. The structure of the additional information is the same as that of the first embodiment (see Fig. 12C). In other words, the additional information contains an area IN (2 bytes) as an ID, an area key code ID (1 byte), an area SIZE (2 bytes) that represents the size of each

additional information area, and a maker code area MCode (2 bytes). In addition, the additional information contains an area SID (1 byte) as a sub ID.

According to the second embodiment of the present invention, in addition to the file system defined as a format of the memory card, the track information management file TRKLIST for music data is used. Thus, even if the FAT is destroyed, the file can be recovered. Fig. 33 shows a flow of a file recovering process. To recover the file, a computer that operates with a file recovery program and that can access the memory card and a storing device (hard disk, RAM, or the like) connected to the computer are used. The computer has a function equivalent to the DSP30. Next, a file recovering process using the track management file TRKLIST will be described.

All blocks of the flash memory whose FAT has been destroyed are searched for TL-0 as the value (BLKID) at the top position of each block. In addition, all the blocks are searched for NM-1 as the value (BLKID) at the top position of each block. Thereafter, all the blocks are searched for NM-2 as the value (BLKID) at the top position of each block. All the contents of the four blocks (track information management file) are stored to for example a hard disk by the recovery computer.

The number of total tracks is obtained from

data after the fourth byte of the track information management file. The 20-th byte of the track information area TRKINF-001, the value of the area CONNUM-001 of the first music program, and the value of the next area P-001 are obtained. The number of parts is obtained with the value of the area P-001. The values of the areas PRTSIZE of all parts of the track 1 of the area PRTINF is obtained. The number of total blocks (clusters) n is calculated and obtained.

After the track information management file is obtained, the flow advances to step 102. At step 102, a voice data file (ATRAC3 data file) is searched. All blocks of other than the management file is searched from the flash memory. Blocks whose top value (BLKID) is A3D are collected.

A block of which the value of the area CONNUM0 at the 16-th byte of A3Dnnnn is the same as that of the area CONNUM-001 of the first music program of the track information management file and of which the value of the area BLOCK SERIAL that starts from 20-th byte is 0 is searched. After the first block is obtained, a block (cluster) with the same value of the area CONNUM value as the first block and of which the value of BLOCK SERIAL is incremented by 1 (1 = 0 + 1) is searched. After the second block is obtained, a block with the same value of the area CONNUM0 as the second block and of which the value of the area BLOCK

SERIAL is incremented by 1 (2 = 1 + 1) is searched.

By repeating the process, the ATRC3 data file is searched until n blocks (clusters) of the track 1 are obtained. When all the blocks (clusters) are obtained, they are successively stored to the hard disk.

The same process for the track 1 is performed for the track 2. In other words, a block of which the value of the area CONNUM0 is the same as that of the area CONNUM-002 of the first music program of the track information management file and of which the value of the area BLOCK SERIAL that starts at the 20-th byte is searched. Thereafter, in the same manner as the track 1, the ATRAC3 data file is searched until the last block (cluster) n' is detected. After all blocks (clusters) are obtained, they are successively stored to the hard disk.

By repeating the above-described process for all tracks (the number of tracks: m), all the ATRAC3 data is stored to the hard disk controlled by the recovering computer.

At step 103, the memory card whose the FAT has been destroyed is re-initialized and then the FAT is reconstructed. A predetermined directory is formed in the memory card. Thereafter, the track information management file and the ATRAC3 data file for m tracks are copied from the hard disk to the memory card.

Thus, the recovery process is finished.

In the management file and data file, important parameters (in particular, codes in headers) may be recorded triply rather than doubly. When data is redundantly recorded, the same data may be recorded at any positions as long as they are apart from each other for one page or more.

According to the present invention, the abnormality of a data file (ATRAC3 file) recorded in a memory card is detected. Next, with reference to Figs. 25 to 32, a circuit block that detects the abnormality of data will be described in detail.

As is clear from Fig. 20, the compression rate expected for conventional memory cards is around 1/8 to 1/43. In the case of 1024 samples/channel used for ATRAC3, the SU data amount (hereinafter referred to as SU value) as the data unit of the compressing process is in the range from 256 bytes to 48 bytes.

Each block contains 50 SU. According to the embodiment of the present invention, by detecting a particular fixed value of one byte that is set to SU at the beginning of one block of decrypted data, it can be determined whether or not the audio data has been correctly encrypted. For example, the determination can be performed at intervals of one second. When abnormally reproduced data is detected, it is quickly muted and/or a message that represents the abnormality

is displayed. In the recorder shown in Fig. 1, the D/A converter 18 performs the muting process so as to prevent abnormally reproduced output data from being generated. Alternatively, when abnormally reproduced output data is detected, the decompressing process may be prohibited.

Next, with reference to a block diagram shown in Fig. 34, the embodiment of the present invention in the case that data is recorded will be described. As shown in Fig. 1, the audio encoder/decoder IC 10 supplies audio data that has been compressed corresponding to ATRAC3 to the security IC 20. In Fig. 34, ATRAC3 compressed audio data is supplied from an audio encoder 71 to a shift register 74 of a detecting portion 73. The shift register 74 supplies the audio data to an encrypter 77. As an example, a serial signal shown in Fig. 35 is supplied from the audio encoder 71 to the shift register 74. The timing at which the compressed audio data is output from the audio encoder 71 to the shift register 74 is controlled by a byte counter 72. In addition, the first read block is pre-set to the byte counter 72.

One block contains around 50 SU. When the first one byte of the first SU is stored to the shift register 74, a match detecting circuit 75 determines whether or not the high order six bits of the first byte o the first SU of the block matches a fixed value

VF1 (namely, 101000). The match detecting circuit 75 outputs the determined result Sc1. In such a manner, the detecting portion 73 determines whether or not the fixed value VF1 has been set to the first byte of one SU of ATRAC3 data. The encrypter 77 encrypts the supplied audio data with a key 78. The data encrypted by the encrypter 77 is written to a memory card 40. In addition, the data encrypted by the encrypter 77 is supplied to a decrypter 81.

The decrypter 81 decrypts encrypted data with a key 82 that is the same as the key 78. Thus, the encrypted data is converted into a serial signal shown in Fig. 35. The serial signal that is output from the decrypter 81 is supplied to a shift register 85 of a detecting portion 84. The timing at which the serial data is output from the decrypter 81 to the shift register 85 is controlled by a byte counter 83. The first read block is pre-set to the byte counter 83. The first one byte of the first one of 50 SU contained in one block is stored to the shift register 85. A match detecting circuit 86 determines whether or not the high order six bits of the one byte matches a fixed value VF2 (namely, 101000). The match detecting circuit 86 outputs the determined result Sc2.

The determined result Sc1 that is output from the match detecting circuit 75 is ANDed with the determined result Sc2 that is output from the match

detecting circuit 86. In other words, when the high order six bits of one byte stored in the shift register 74 matches the fixed value VF1 and the high order six bits of one byte stored in the shift register 85 matches the fixed value VF2 as the determined results of the match detecting circuits 75 and 86, a status that represents that the header is OK is output. Otherwise, the reproduced audio data is muted. When audio data is recorded, an alarm is issued. Alternatively, the system is reset and then it is determined whether reproduced output data becomes normal.

Actually, it is difficult to set the fixed values VF1 and VF2 at intervals of for example 50 SU. Thus, the fixed values VF1 and VF2 are set to all SU. Only parts of 50 SU are extracted. When the fixed values VF1 and VF2 cannot be detected, an error flag is placed.

When the fixed values are set to all SU, abnormalities due to such as a different compression mode and a phase deviation of LR channels can be also detected. In reality, as shown in Fig. 21, according to the embodiment of the present invention, there are two compression modes that are Dual mode and Joint mode. In addition, there is monaural mode. Thus, there are a total of three recording methods.

One byte of the header is defined as follows.

101000 - 00: Dual (L)

101000 - 01: Dual (R)

101000 - 10: Joint

101000 - 11: Monaural

The match detecting circuit 75 or 86 determines whether or not the high order six bits of one byte stored in the shift register 74 or 85 matches the fixed value VF1 or VF2. The low order two bits of one byte stored in the shift register 74 or 85 define recording methods. Thus, both the abnormality of audio data and the compression mode can be detected at the same time. In addition, since the compression mode is detected, a confusion of which different compression modes are combined can be prevented.

Next, with reference to Fig. 36, a process for reproducing encrypted data recorded in a memory card 40 will be described. For simplicity, in Fig. 36, similar functional blocks to those shown in Fig. 34 are denoted by similar reference numerals and their description is omitted. Encrypted data that is read from the memory card 40 is supplied to a decrypting circuit 81. A detecting portion 84 detects abnormally reproduced output audio data. When the reproduced output data is abnormal as the detected result of the detecting portion 84, the abnormally reproduced output data is immediately muted. As descried above, a muting signal is supplied to a D/A converter 18. Data that is

output from the shift register 85 is supplied to an audio decoder 88. The audio decoder 88 reproduces the supplied data.

As a real example of the encrypting process performed by the encrypter 77, CBC (Cipher Block Chaining) mode that is ont of four modes defined for DES will be described. When the CBC mode is used, except for the first block of the track, eight bytes of the last SU of each preceding block is stored. After data is encoded, it is decoded so as to determine whether the fixed value at the beginning of the next block can be reproduced every second block (at intervals of around 1 second).

In the CBC mode, the first eight bytes P1 of the first SU of the first block of the track are exclusive-ORed with an initialization vector INV. The resultant data is encrypted with a key K. Thus, the following relation is satisfied.

DES (P1 (+) INV, K) = C1

where DES: symbol of encrypting process, Pi: plane data, Ci: encrypted data, K: key, and (+): symbol of exclusive-OR operation.

To encrypt other than the first block of the track, the immediately encrypted output data (encrypted data) C1 is required. The next eight bytes are encrypted as follows.

DES (P2 (+) C1, K) = C2

DES is performed every eight bytes. Thus, to encrypt the first eight bytes (beginning data) of the block, the last eight bytes (preceding data) that have been encrypted of the preceding SU are required. Thus, the encrypter 77 requires a temporary storage memory that stores the beginning data and the preceding data.

The decrypter 81 decrypts the encrypted data. Thus, the following relation is satisfied.

IDES (C1, K) (+) INV

= P1 (+) INV (+) INV = P1

where IDES: decrypting process

To decrypt other than the first block of the track, the preceding encrypted data C1 is required. Thus, the next eight bytes are decrypted as follows.

IDES (C2, K) (+) C1

= P2 (+) C1 (+) C1 = P2

As with the encrypting process, IDES is performed every eight bytes. Thus, to decrypt eight bytes at the beginning (beginning data) of encrypted data of a block, the last eight bytes (preceding data) of encrypted data of the preceding SU of the block is required. Thus, the decrypter 81 requires a temporary storage memory that stores the beginning data and the preceding data.

In such a manner, when data is recorded, ATRAC3 data can be checked. When the decrypter has a temporary storage memory that temporarily stores the

beginning data and the preceding data of a block of encrypted data, the encrypted data can be also checked.

Fig. 37 is a block diagram showing the structure of a recording and reproducing apparatus according to the present invention. A digital audio signal is supplied from a CD or Internet to an input terminal 91. The digital audio signal is supplied to an ATRAC3 encoder 92. The ATRAC3 encoder 92 performs a highly efficient encoding process for the digital audio signal so as to compress it.

The digital audio signal compressed by the ATRAC3 encoder 92 is converted into blocks corresponding to the sound unit (SU).

The data length of the sound unit is variable in the range from 48 bytes to 256 bytes. This is because the ATRAC3 encoding method allows data to be compressed at a variable rate.

A fixed value generating device 93 outputs a fixed value VF1 at a predetermined timing. An adding device 95 adds the fixed value VF1 that is output from the fixed value generating device 93 to the block-segmented compressed digital audio signal that is output from the ATRAC3 encoder 92.

The timing at which the adding device 95 adds the fixed value VF1 to the compressed digital audio data is controlled by a timing controlling device 94.

The timing controlling device 94 may control

the timing so that the fixed value VF1 is added to the first one of 50 sound units as an encoding unit as will be described later.

In this case, the timing controlling device 94 counts block information that is output from the ATRAC3 encoder 92 so as to control the fixed value generating device 93.

Alternatively, the timing controlling device 94 may add the fixed value VF1 to all sound units that are output from the ATRAC3 encoder 92.

In this case, the fixed value is extracted at the timing of which encrypted data is decrypted (at intervals of 50 sound units). In this case, the fixed value added to the remaining sound units is discarded.

The compressed digital audio signal and the fixed value added by the adding device 95 are encrypted by an encrypter 96 with a key that is output from a key storing portion 97 corresponding to a predetermined encrypting process. According to the embodiment of the present invention, the encrypting process is performed corresponding to DES (Data Encryption Standard).

The compressed digital audio signal and the fixed value encrypted by the encrypter 96 are recorded as predetermined blocks to a non-volatile memory 98.

In the above-described example, the fixed value generating device 93 generates only one fixed value that is VF1. Alternatively, the fixed value

generating device 93 may generate a plurality of fixed values corresponding to the number of audio channels.

In addition, according to the present invention, as described above, since the variable rate compressing method is used, fixed values may be varied corresponding to compression rates.

When encrypted data is decrypted, a digital audio signal that has been encrypted and compressed is read from the non-volatile memory 98. The digital audio signal is decrypted by a decrypter 99 with a key that is output from a key storing portion 100.

The digital audio signal that has been decrypted by the decrypter 99 is output as blocks of ATRAC3 data.

The fixed value VF is added to the ATRAC3 data at predetermined intervals.

A subtracting device 102 separates the ATRAC3 data from the fixed value VF at the timing controlled by the timing controlling device 101. The block information that is output from the decrypter 99 is supplied to the timing controlling device 101. The timing controlling device 101 controls the timing at which the fixed value is extracted.

A comparing device 104 compares the fixed value VF extracted by the subtracting device 102 with the fixed value stored in the fixed value memory 103.

When they match, the comparing device 104

determines that the encrypter 96 and the decrypter 99 have normally performed the encrypting process and the decrypting process, respectively.

When the encrypting process and the decrypting process have been normally performed as the compared result of the comparing device 104, the compared result allows the ATRAC3 decoder 105 to decode the ATRAC3 data.

On the other hand, when the encrypting process and the decrypting process have been abnormally performed as the compared result of the comparing device 104, the compared result prohibits the ATRAC3 decoder 105 from decoding the ATRAC3 data.

Thus, depending on whether or not the encrypting process and the decrypting process have been normally performed, the decoding process for the compressed audio data is permitted or prohibited. When audio data is encoded, if fixed values corresponding to channels are added, the fixed values are pre-stored to the fixed value memory 103. When audio data is decoded, the comparing device 104 compares the fixed values stored in the fixed value memory 103 with the fixed value VF extracted by the subtracting device 104 so as to detect an audio channel. Corresponding to the detected audio channel, the decompressing process of the ATRAC3 decoder 105 is controlled.

In the case that fixed values corresponding

to compression rates are added, the fixed values are pre-stored in the fixed value memory 103. The comparing device 104 compares the fixed values stored in the fixed value storing memory 103 with the fixed value VF extracted by the subtracting device 102 so as to detect a compression rate. Corresponding to the detected compression rate, the decompressing process of the ATRAC3 decoder 105 is controlled.

According to the present invention, even if audio data has been encrypted, corresponding to the value of one byte of the first SU of each block, it can be determined whether or not the block is normal. Thus, abnormal reproduced data can be prevented from being output. When data that has been recorded is reproduced, if it becomes abnormal, it can be prevented from being reproduced. In addition, the compression mode can be detected. Thus, a confusion of which different compression modes are combined can be prevented.

CLAIMS

1. A recording apparatus, comprising:

compression process means for compressing an input digital signal corresponding to a predetermined compression process and segmenting the compressed digital signal into blocks;

fixed value generating means for generating a predetermined fixed value;

adding means for adding the fixed value generated by said fixed value generating means at a predetermined timing to the blocks of the digital signal compressed by said compression process means;

encrypting means for encrypting the fixed value and the compressed digital signal added by said adding means; and

recording means for recording the fixed value and the compressed digital signal encrypted by said encrypting means to a record medium.

2. The recording apparatus as set forth in claim 1,

wherein the record medium is attachable/detachable to/from the recording apparatus.

3. The recording apparatus as set forth in claim 1,

wherein the record medium is a non-volatile memory.

4. The recording apparatus as set forth in claim

1,

wherein the fixed value generated by said fixed value generating means is varied corresponding to a compression rate.

5. The recording apparatus as set forth in claim 1,

wherein the digital signal is a digital audio signal, and

wherein the fixed value generated by said fixed value generating means is varied corresponding to a channel.

6. The recording apparatus as set forth in claim 1,

wherein when a plurality of blocks of the compressed digital signal compose the minimum encrypting unit, the fixed value is added to the first block of the plurality of blocks by said adding means.

7. The recording apparatus as set forth in claim 1,

wherein the fixed value is added to all blocks of the plurality of blocks by said adding means.

8. A recording method, comprising the steps of:

compressing an input digital signal corresponding to a predetermined compression process and segmenting the compressed digital signal into blocks;

generating a predetermined fixed value;

adding the generated fixed value at a predetermined timing to the blocks of the compressed digital signal;

encrypting the fixed value and the compressed digital signal that have been added; and

recording the fixed value and the compressed digital signal that have been encrypted to a record medium.

9. The recording method as set forth in claim 8, wherein the record medium is attachable/detachable to/from a recording apparatus.

10. The recording method as set forth in claim 8, wherein the record medium is a non-volatile memory.

11. The recording method as set forth in claim 8, wherein the fixed value is varied corresponding to a compression rate.

12. The recording method as set forth in claim 8, wherein the digital signal is a digital audio signal, and

wherein the fixed value is varied corresponding to a channel.

13. The recording method as set forth in claim 8, wherein when a plurality of blocks of the compressed digital signal compose the minimum encrypting unit, the fixed value is added to the first block of the plurality of blocks.

14. The recording method as set forth in claim 8, wherein the fixed value is added to all blocks of the plurality of blocks.

15. A reproducing apparatus for reproducing data of which a digital signal of which a fixed value is added at a predetermined timing to blocks of main data is compressed and encrypted from a record medium, comprising:

decrypting means for decrypting the compressed and encrypted digital signal;

separating means for separating the fixed value and the compressed data from the digital signal that are decrypted by said decrypting means;

decompressing means for decompressing the compressed main data separated by said separating means;

memory means for pre-storing a fixed value;

comparing means for comparing the fixed value separated by said separating means with the fixed value stored in said memory means; and

controlling means for permitting and prohibiting the decompressing process of said decompressing means for the main data decompressed by said decompressing means corresponding to the compared result of said comparing means.

16. The reproducing apparatus as set forth in claim 15,

wherein the record medium is attachable/detachable to/from the reproducing apparatus.

17. The reproducing apparatus as set forth in claim 15,

wherein the record medium is a non-volatile memory.

18. The reproducing apparatus as set forth in claim 15,

wherein said memory means stores a plurality of fixed values that vary corresponding to channels,

wherein the plurality of fixed values stored in said memory means are successively compared with the fixed value separated from said separating means so as to identify a channel.

19. The reproducing apparatus as set forth in claim 15,

wherein said memory means stores a plurality of fixed values that vary corresponding to compression rates,

wherein the plurality of fixed values stored in said memory means are successively compared with the fixed value separated from said separating means so as to identify a compression rate.

20. The reproducing apparatus as set forth in claim 15,

wherein the decompressing process is

permitted for the compressed main data corresponding to the compared result in such a manner that a mute process is performed for the decompressed main data.

21. A reproducing method for reproducing data of which a digital signal of which a fixed value is added at a predetermined timing to blocks of main data is compressed and encrypted from a record medium, comprising the steps of:

decrypting the compressed and encrypted digital signal;

separating the fixed value and the compressed data from the digital signal that are decrypted;

decompressing the compressed main data that is separated;

comparing the separated fixed value with the fixed value that is stored; and

permitting and prohibiting the decompressing process of comparing step for the main data that is decompressed corresponding to the compared result of comparing step.

22. The reproducing method as set forth in claim 21,

wherein the record medium is attachable/detachable to/from a reproducing apparatus.

23. The reproducing method as set forth in claim 21,

wherein the record medium is a non-volatile

memory.

24. The reproducing method as set forth in claim 21,

wherein a plurality of fixed values that vary corresponding to channels are pre-stored, and

wherein the plurality of fixed values that are pre-stored are successively compared with the fixed value separated at separating step so as to identify a channel.

25. The reproducing method as set forth in claim 21,

wherein a plurality of fixed values that vary corresponding to compression rates are pre-stored, and

wherein the plurality of fixed values that are pre-stored are successively compared with the fixed value separated at separating step so as to identify a compression rate.

26. The reproducing method as set forth in claim 21,

wherein the decompressing process is permitted for the compressed main data corresponding to the compared result in such a manner that a mute process is performed for the decompressed main data.

ABSTRACT

A recording apparatus is disclosed, that comprises a compression process means for compressing an input digital signal corresponding to a predetermined compression process and segmenting the compressed digital signal into blocks, a fixed value generating means for generating a predetermined fixed value, an adding means for adding the fixed value generated by the fixed value generating means at a predetermined timing to the blocks of the digital signal compressed by the compression process means, an encrypting means for encrypting the fixed value and the compressed digital signal added by the adding means, and a recording means for recording the fixed value and the compressed digital signal encrypted by the encrypting means to a record medium.

Fig. 1

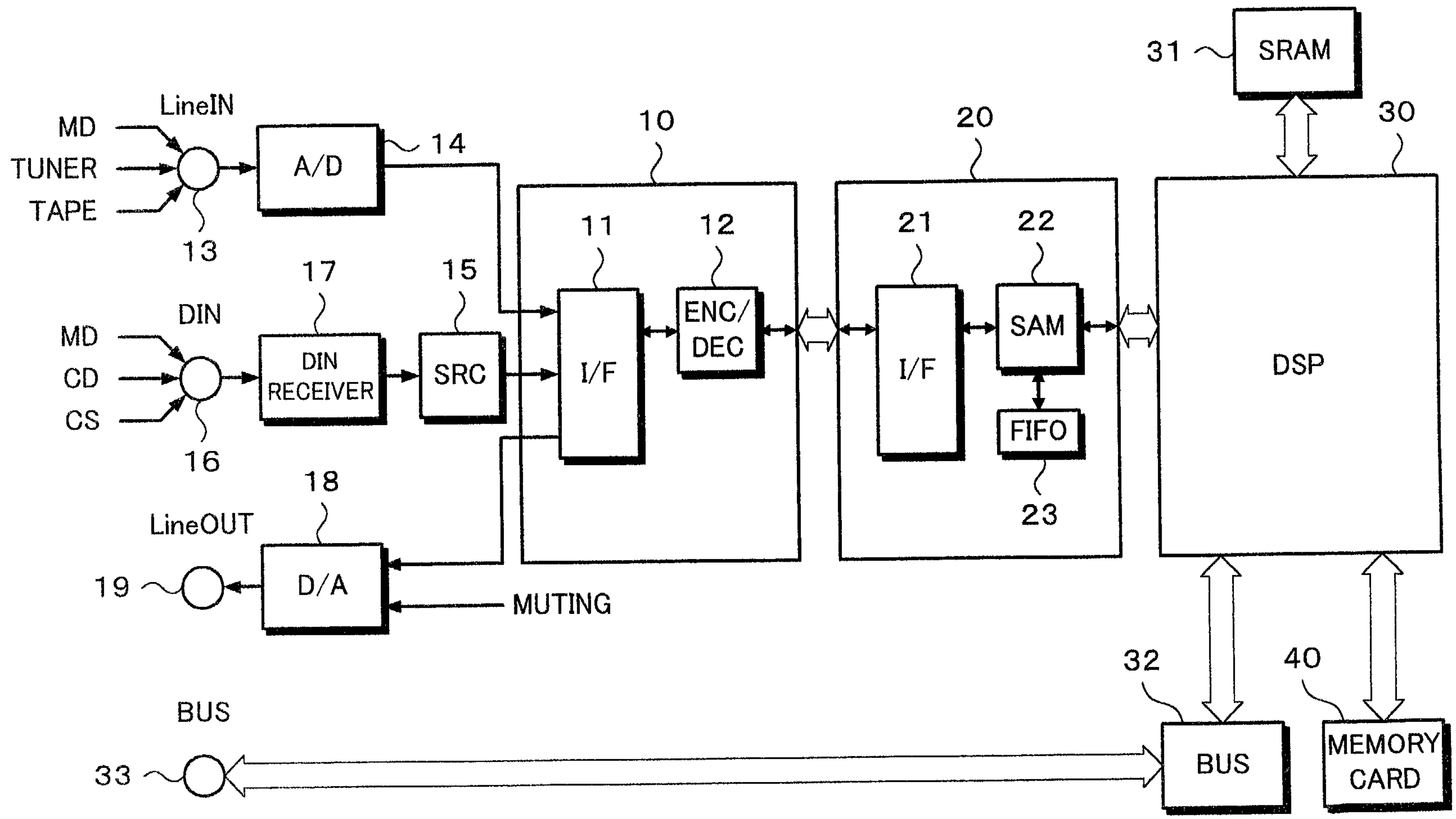

MD
TUNER
TAPE
LineIN
13
A/D
14
MD
CD
CS
DIN
16
DIN RECEIVER
17
SRC
15
LineOUT
19
D/A
18
MUTING
BUS
33
10
11
I/F
12
ENC/DEC
20
21
I/F
22
SAM
FIFO
23
30
DSP
31
SRAM
32
BUS
40
MEMORY CARD

Fig. 2

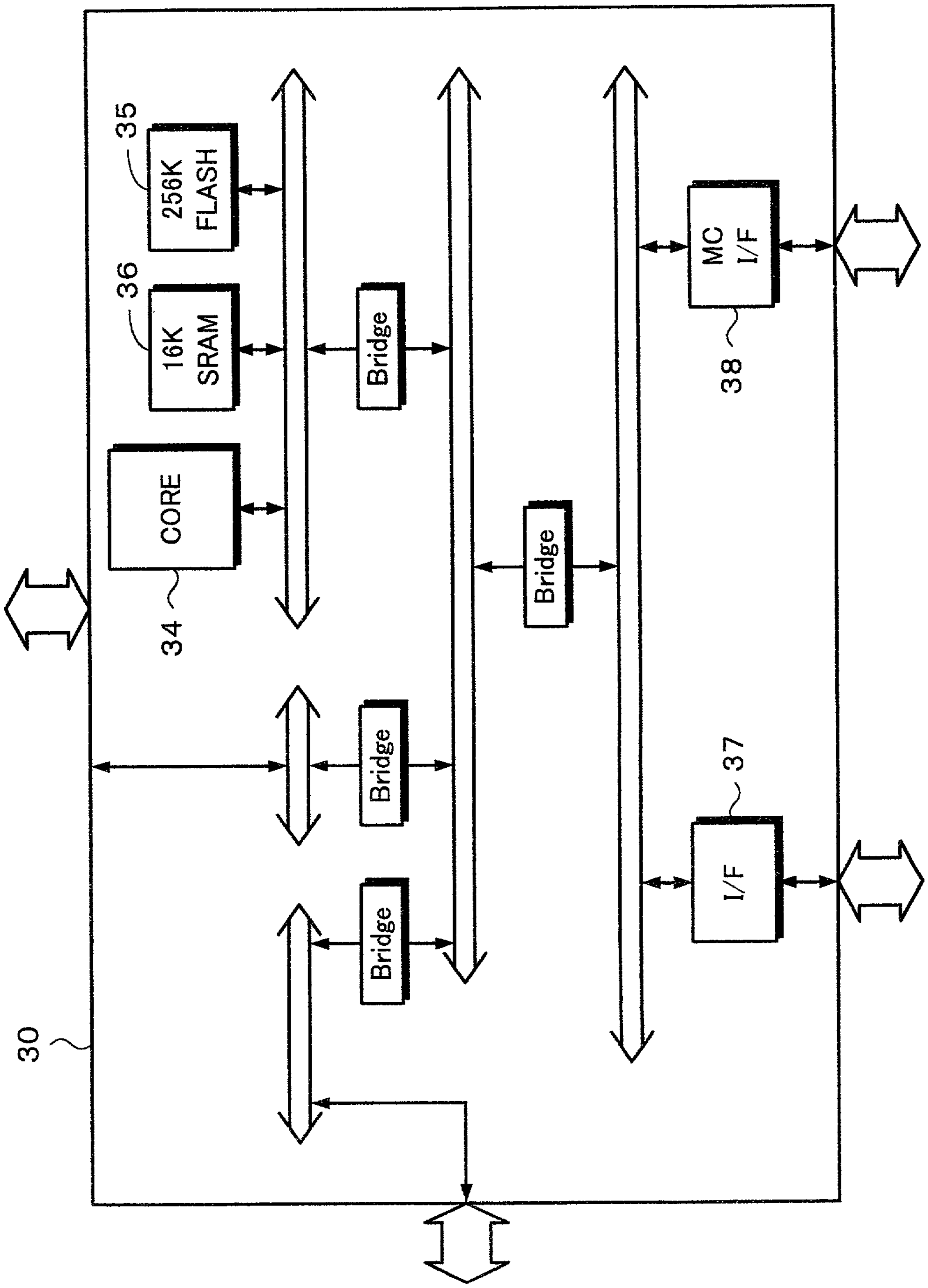

30
34
CORE
35
256K FLASH
36
16K SRAM
Bridge
Bridge
Bridge
Bridge
37
I/F
38
MC I/F

Fig. 3

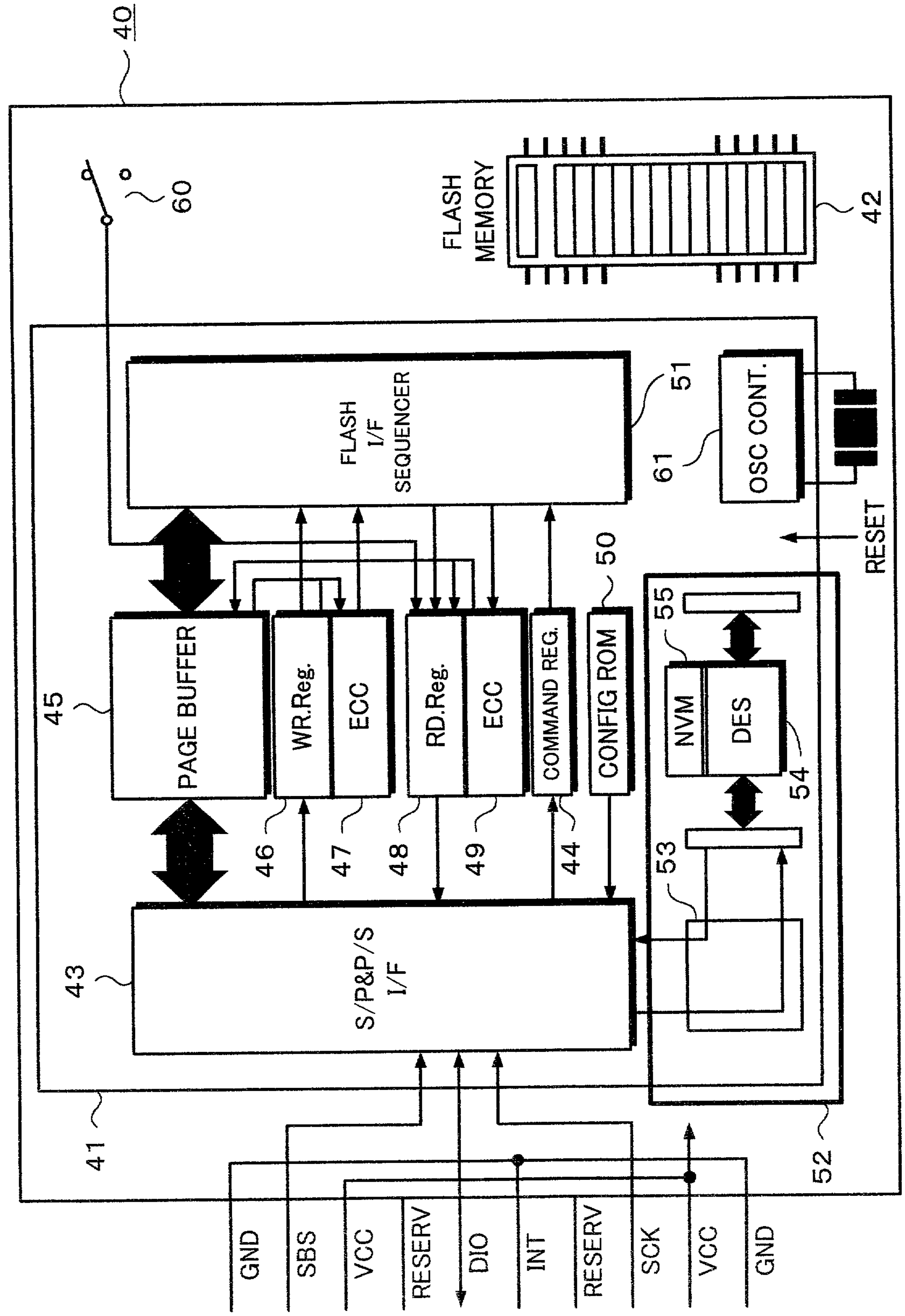
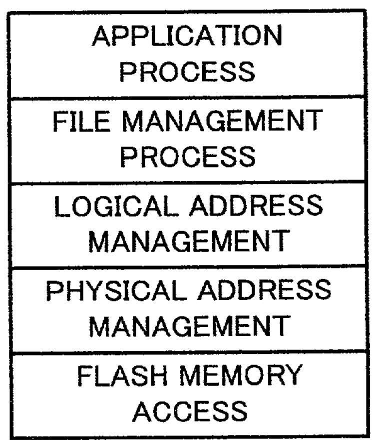

40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
60
61
FLASH MEMORY
FLASH I/F SEQUENCER
OSC CONT.
RESET
PAGE BUFFER
WR.Reg.
ECC
RD.Reg.
ECC
COMMAND REG.
CONFIG ROM
NVM
DES
S/P&P/S I/F
GND
SBS
VCC
RESERV
DIO
INT
RESERV
SCK
VCC
GND

Fig. 4



FILE SYSTEM PROCESS HIERARCHY

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Fig. 5

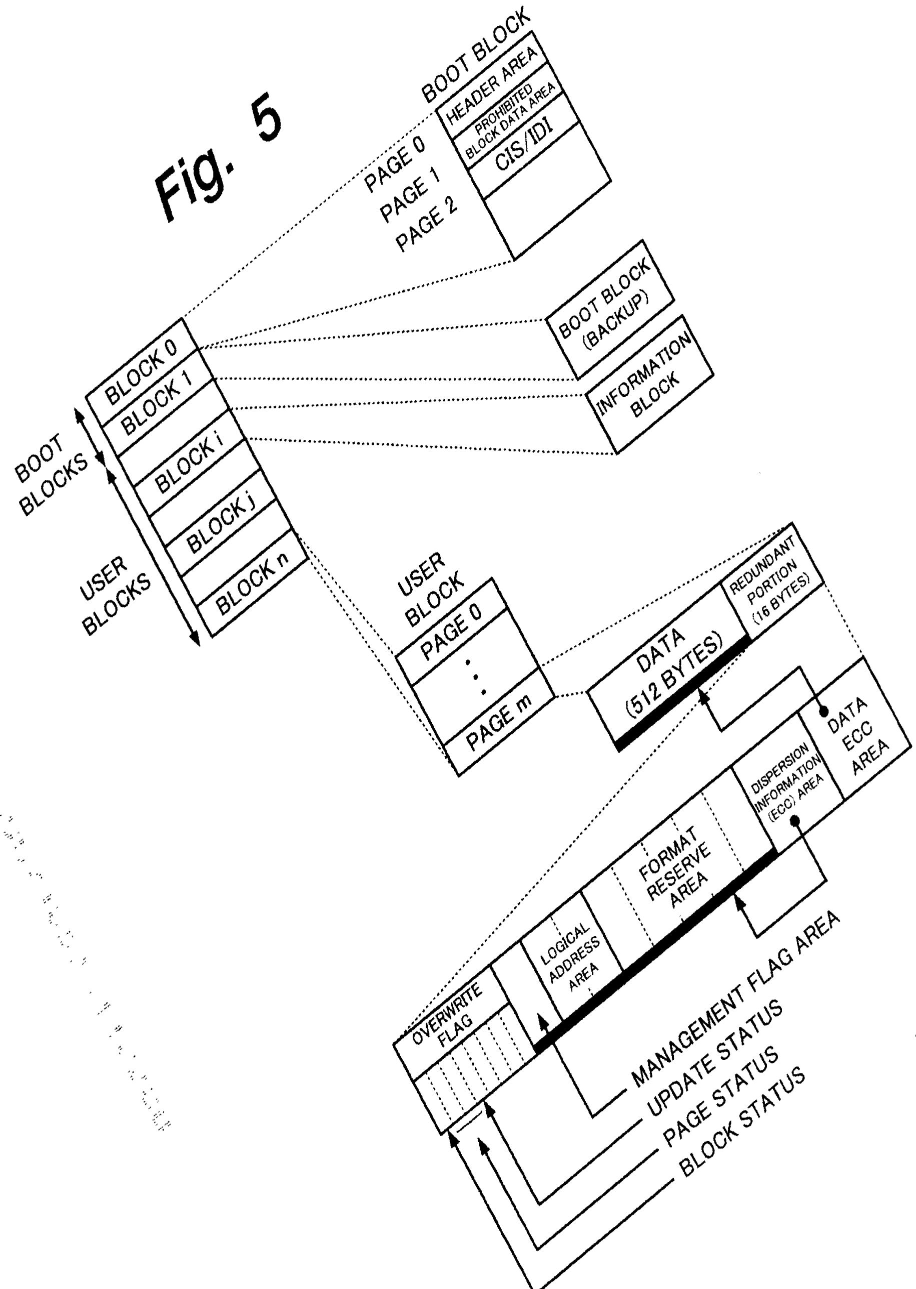

Fig. 6

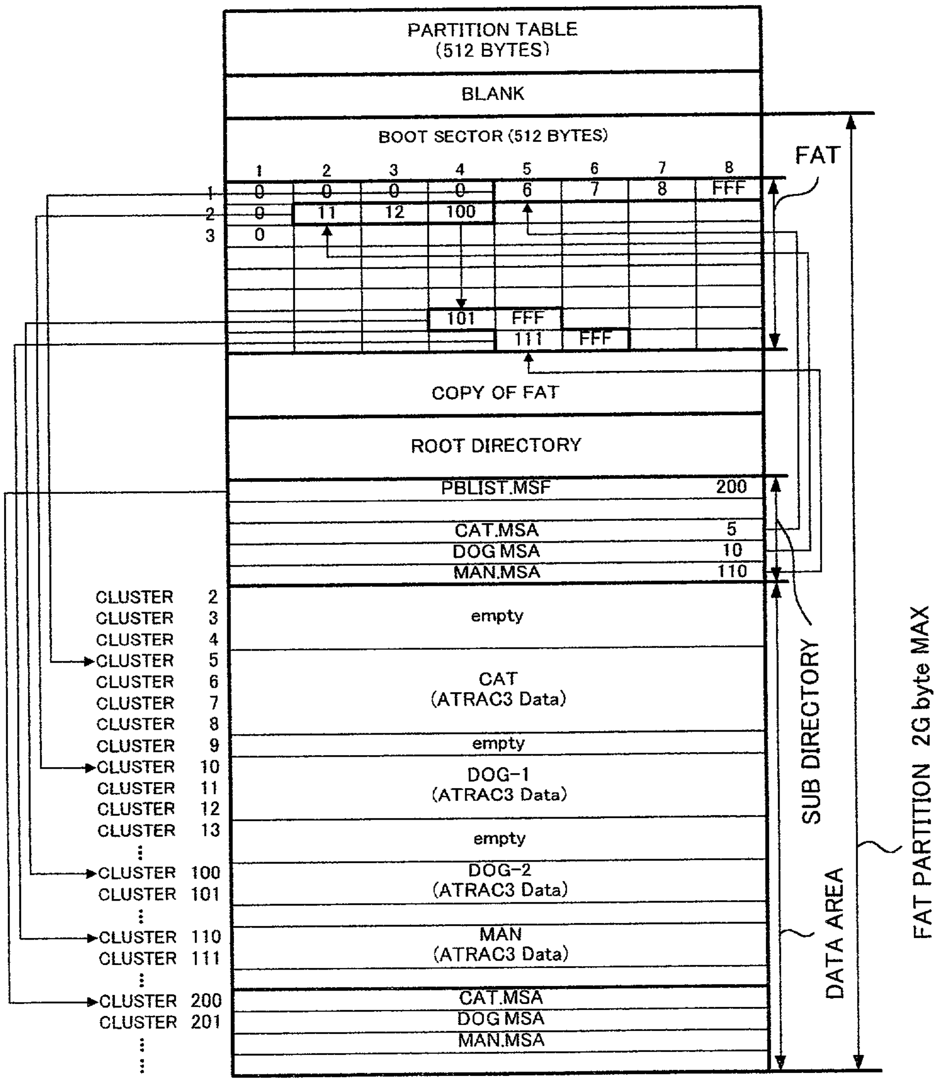
PARTITION TABLE
(512 BYTES)
BLANK
BOOT SECTOR (512 BYTES)
1 2 3 4 5 6 7 8
1 0 0 0 0 6 7 8 FFF
2 0 11 12 100
3 0
101 FFF
111 FFF
FAT
COPY OF FAT
ROOT DIRECTORY
PBLIST.MSF 200
CAT.MSA 5
DOG.MSA 10
MAN.MSA 110
CLUSTER 2
CLUSTER 3
CLUSTER 4
CLUSTER 5
CLUSTER 6
CLUSTER 7
CLUSTER 8
CLUSTER 9
CLUSTER 10
CLUSTER 11
CLUSTER 12
CLUSTER 13
CLUSTER 100
CLUSTER 101
CLUSTER 110
CLUSTER 111
CLUSTER 200
CLUSTER 201
empty
CAT
(ATRAC3 Data)
empty
DOG-1
(ATRAC3 Data)
empty
DOG-2
(ATRAC3 Data)
MAN
(ATRAC3 Data)
CAT.MSA
DOG.MSA
MAN.MSA
SUB DIRECTORY
DATA AREA
FAT PARTITION 2G byte MAX

Fig. 7

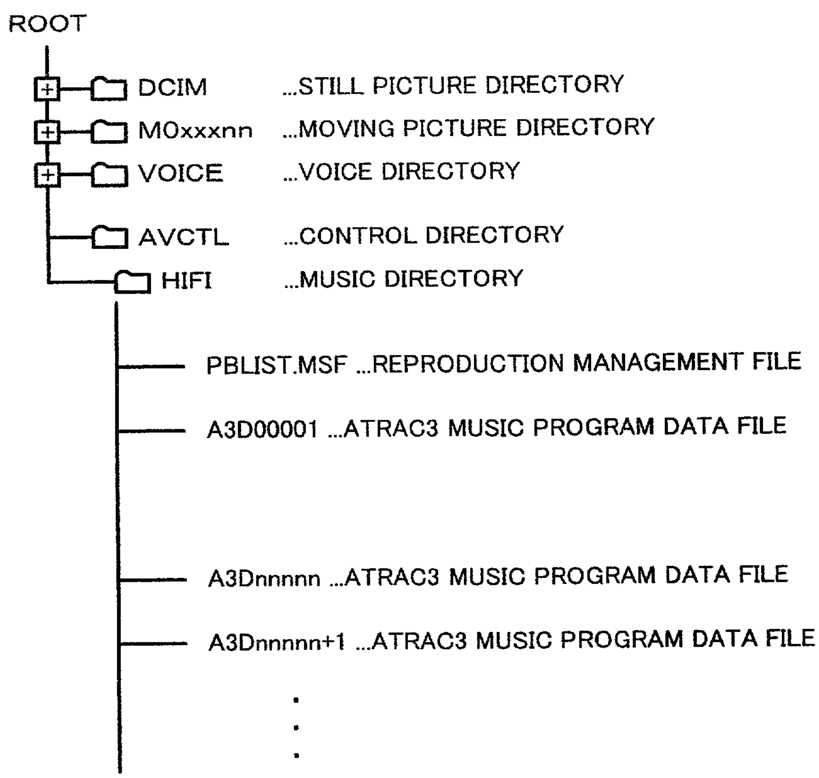
ROOT
DCIM ...STILL PICTURE DIRECTORY
MOxxxnn ...MOVING PICTURE DIRECTORY
VOICE ...VOICE DIRECTORY
AVCTL ...CONTROL DIRECTORY
HIFI ...MUSIC DIRECTORY
PBLIST.MSF ...REPRODUCTION MANAGEMENT FILE
A3D00001 ...ATRAC3 MUSIC PROGRAM DATA FILE
A3Dnnnnn ...ATRAC3 MUSIC PROGRAM DATA FILE
A3Dnnnnn+1 ...ATRAC3 MUSIC PROGRAM DATA FILE

Fig. 8

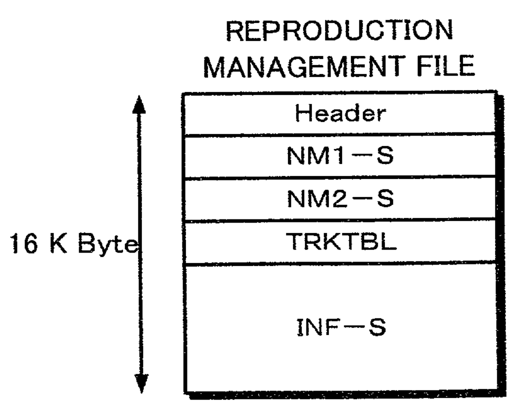
REPRODUCTION
MANAGEMENT FILE
16 K Byte
Header
NM1−S
NM2−S
TRKTBL
INF−S

Fig. 9

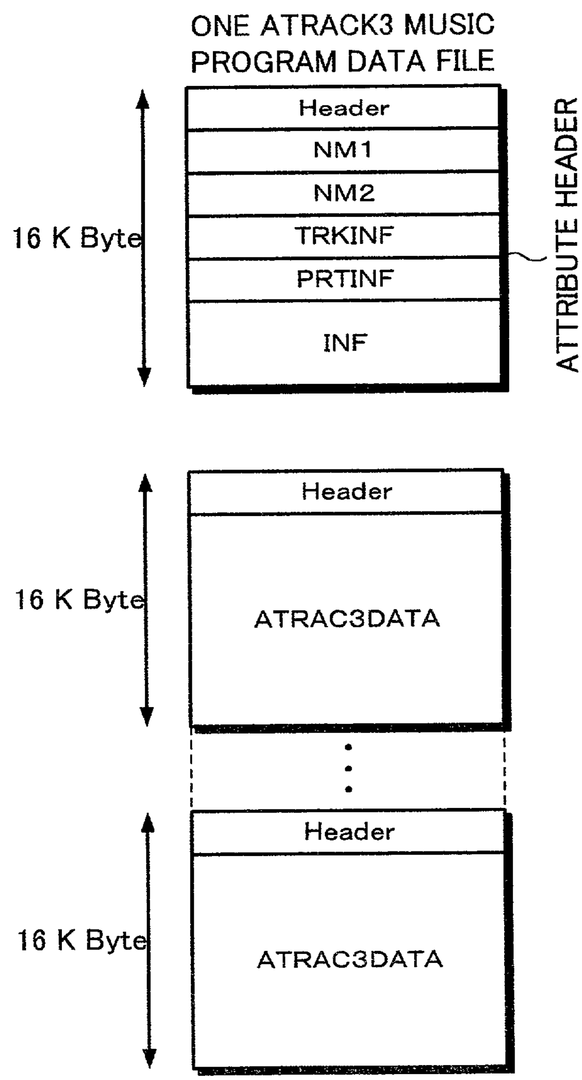
ONE ATRACK3 MUSIC
PROGRAM DATA FILE
Header
NM1
NM2
TRKINF
PRTINF
INF
ATTRIBUTE HEADER
16 K Byte
Header
ATRAC3DATA
16 K Byte
Header
ATRAC3DATA
16 K Byte

Fig. 10A

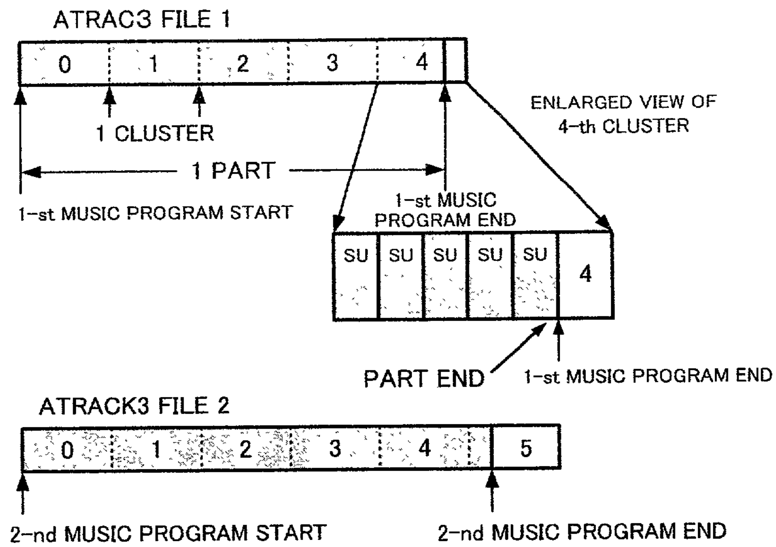

Fig. 10B

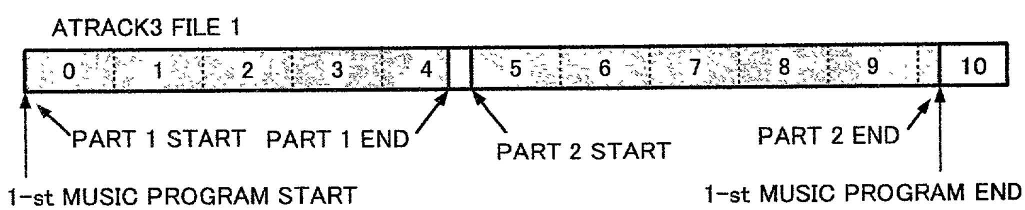

Fig. 10C

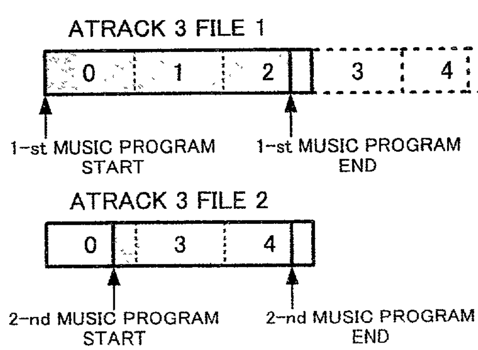

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Fig. 11

REPRODUCTION MANAGEMENT FILE (PBLIST)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0X0000	BLKID−TL0				Reserved		MCode		REVISION				Reserved			
0X0010	SN1C+L		SN2C+L		SINFSIZE		T−TRK		VerNo		Reserved					
0X0020	NM1−S(256)															
0X0120	NM2−S(512)															
0X0320	Reserved								CONTENTSKEY							
0X0330	Reserved								MAC							
	Reserved												S−YMDhms			
0X0350	TRK−001		TRK−002		TRK−003		TRK−004		TRK−005		TRK−006		TRK−007		TRK−008	
	TRK−009		TRK−010		TRK−011		TRK−012		TRK−013		TRK−014		TRK−015		TRK−016	
0X0660	TRK−393		TRK−394		TRK−395		TRK−396		TRK−397		TRK−398		TRK−399		TRK−400	
0X0647	INF−S(14720)															
0X3FF0	BLKID−TL0				Reserved		MCode		REVISION				Reserved			

TRKTBL

Fig. 12A

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0X0000	BLKID−TL0				Reserved		MCode		REVISION				Reserved			
0X0010	SN1C+L		SN2C+L		SINFSIZE		T−TRK		VerNo		Reserved					

Fig. 12B

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0X0020	NM1−S(256)															
0X0120	NM2−S(512)															
0X0320	Reserved								CONTENTSKEY							
0X0330	Reserved								MAC							
	Reserved												S−YMDhms			
0X0350	TRK−001		TRK−002		TRK−003		TRK−004		TRK−005		TRK−006		TRK−007		TRK−008	
0X0360	TRK−009		TRK−010		TRK−011		TRK−012		TRK−013		TRK−014		TRK−015		TRK−016	
0X0660	TRK−393		TRK−394		TRK−395		TRK−396		TRK−397		TRK−398		TRK−399		TRK−400	
0X0670	INF−S(14720)															
0X3FF0	BLKID−TL0				Reserved		MCode		REVISION				Reserved			

Fig. 12C

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
INF	0x00	ID	0x00	SIZE		MCode		C+L		Reserved		DATA VARIABLE LENGTH			

Fig. 13

ID	MUSIC INFORMATION (CHARACTERS)		ID	URL INFORMATION (WEB INFORMATION)	
0	RESERVED		32	RESERVED	
1	ALBUM	VARIABLE	33	ALBUM	VARIABLE
2	SUBTITLE	VARIABLE	34	SUB TITLE	VARIABLE
3	ARTIST	VARIABLE	35	ARTIST	VARIABLE
4	CONDUCTOR	VARIABLE	36	CONDUCTOR	VARIABLE
5	ORCHESTRA	VARIABLE	37	ORCHESTRA	VARIABLE
6	PRODUCER	VARIABLE	38	PRODUCER	VARIABLE
7	PUBLISHER	VARIABLE	39	PUBLISHER	VARIABLE
8	COMPOSER	VARIABLE	40	COMPOSER	VARIABLE
9	SONG WRITER	VARIABLE	41	SONG WRITER	VARIABLE
10	ARRANGER	VARIABLE	42	ARRANGER	VARIABLE
11	SPONSOR	VARIABLE	43	SPONSOR	VARIABLE
12	CM	VARIABLE	44	CM	VARIABLE
13	GUIDE	VARIABLE	45	GUIDE	VARIABLE
14	ORIGINAL MUSIC PROGRAM TITLE	VARIABLE	46	ORIGINAL MUSIC PROGRAM TITLE	VARIABLE
15	ORIGINAL ALBUM TITLE	VARIABLE	47	ORIGINAL ALBUM TITLE	VARIABLE
16	ORIGINAL MUSIC PROGRAM COMPOSER	VARIABLE	48	ORIGINAL MUSIC PROGRAM COMPOSER	VARIABLE
17	ORIGINAL MUSIC PROGRAM SONG WRITER	VARIABLE	49	ORIGINAL MUSIC PROGRAM SONG WRITER	VARIABLE
18	ORIGINAL MUSIC PROGRAM ARRANGER	VARIABLE	50	ORIGINAL MUSIC PROGRAM ARRANGER	VARIABLE
19	ORIGINAL MUSIC PROGRAM PERFORMER	VARIABLE	51	ORIGINAL MUSIC PROGRAM PERFORMER	VARIABLE
20	MESSAGE	VARIABLE	52		
21	COMMENT	VARIABLE	53		
22	WARNING	VARIABLE	54		
23	GENRE	VARIABLE	55		
24			56		
25			57		
26			58		
27			59		
28			60		
29			61		
30			62		
31			63		

Fig. 14

ID	PATH/OTHERS		ID	CONTROL/NUMERIC DATA INFORMATION	
64	RESERVED		96	RESERVED	
65	PATH TO VIDEO DATA	VARIABLE	97	ISRC	8
66	PATH TO SONG DATA	VARIABLE	98	TOC_ID	8
67	PATH TO MIDI DATA	VARIABLE	99	UPC/JAN	7
68	PATH TO GUIDE DATA	VARIABLE	100	RECORDED DATE (YMDhms)	4
69	PATH TO COMMENT DATA	VARIABLE	101	RELEASED DATE	4
70	PATH TO CM DATA	VARIABLE	102	ORIGINAL MUSIC PROGRAM RELEASED DATE (YMDhms)	4
71	PATH TO FAX DATA	VARIABLE	103	RECORDED DATE (YMDhms)	4
72	PATH TO COMMUNICATION DATA 1	VARIABLE	104	SUB TRACK	4
73	PATH TO COMMUNICATION DATA 2	VARIABLE	105	AVERAGE VOLUME LEVEL	1
74	PATH TO CONTROL DATA	VARIABLE	106	RESUME	4
75			107	REPRODUCTION LOG (YMDhms)	4
76			108	NUMBER OF REPRODUCTION TIMES (FOR LEARNING)	1
77			109	PASSWORD 1	16
78			110	APPLevel	16
79			111	GENRE CODE	1
80			112	MIDI DATA	
81			113	THUMB NAIL PHOTOGRAPH DATA	
82			114	TEXT MULTIPLEXED BROADCAST DATA	
83			115	NUMBER OF TOTAL MUSIC PROGRAMS	
84			116	SET NUMBER	
85			117	NUMBER OF TOTAL SETS	
86			118	REC POSITION INFORMATION - GPS	VARIABLE
87			119	PB POSITION INFORMATION - GPS	VARIABLE
88			120	REC POSITION INFORMATION - PHS	VARIABLE
89			121	PB POSITION INFORMATION - PHS	VARIABLE
90			122	CONNECTION DESTINATION TELEPHONE NUMBER 1	VARIABLE
91			123	CONNECTION DESTINATION TELEPHONE NUMBER 2	VARIABLE
92			124	INPUT VALUE	VARIABLE
93			125	OUTPUT VALUE	VARIABLE
94			126	PB CONTROL DATA	VARIABLE
95			127	REC CONTROL DATA	VARIABLE

Fig. 15

ID	SYNCHRONOUS REPRODUCTION INFORMATION	
128	RESERVED	
129	SYNCHRONOUS REPRODUCTION INFORMATION 1	VARIABLE
130	SYNCHRONOUS REPRODUCTION INFORMATION 2	VARIABLE
131	SYNCHRONOUS REPRODUCTION INFORMATION 3	VARIABLE
132	SYNCHRONOUS REPRODUCTION INFORMATION 4	VARIABLE
133	SYNCHRONOUS REPRODUCTION INFORMATION 5	VARIABLE
134	SYNCHRONOUS REPRODUCTION INFORMATION 6	VARIABLE
135		
136		
137		
138	EMD INFORMATION 1	VARIABLE
139	EMD INFORMATION 2	VARIABLE
140		
141		
142		
143		
144		
145		
146		
147		
148		
149		
150		
151		
152		
153		
154		
155		
156		
157		
158		
159		

Fig. 16A

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
IN	0x00	ID	0x00	SIZE		Mcode		C+L		Reseved		VARIABLE LENGTH DATA			

Fig. 16B

ID		ARTIST		SIZE		ASCII ENGLISH						DATA			
0x69	0x00	3	0x00	0x1C(28)		Mcode		0x01	0x09	0x00	0x00	S	I	M	O
N	&	G	R	A	F	U	N	K	E	L	0x00				

Fig. 16C

												ID		ISRC	
												0x69	0x00	97	0x00
SIZE				BINARY NOT SET											
0x14(20)		Mcode		0x00	0x00	0x00	0x00	ISRC Code 8byte							
								DATA							

Fig. 16D

		RECORDED DATE		SIZE				BINARY NOT SET				DATA			
0x69	0x00	103	0x00	0x10(16)		Mcode		0x00	0x00	0x00	0x00	YMD hms			

745 565

Y	M	D	h	m	s

31,30,29 3,2,1,0bit

Fig. 16E

		REPRODUCTION LOG		SIZE				BINARY NOT SET				DATA			
0x69	0x00	107	0x00	0x10(16)		Mcode		0x00	0x00	0x00	0x00	YMD hms			

745 565

Y	M	D	h	m	s

31,30,29 3,2,1,0bit

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Fig. 17

A3Dnnnnn.MSA(ATRAC3 DATA FILE)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x0000	BLKID-HD0				Reserved		MCode		Reseved				BLOCK SERIAL			
0x0010	N1C+L		N2C+L		INFSIZE		T-PRT		T-SU				INX		XT	
0x0020	NM1(256)															
0x0120	NM2(512)															
0x0310																
0x0320	Reserved(8)								CONTENTSKEY							
	Reserved(8)								MAC							
	Reserved(12)												A	LT	FNo	
	MG(D)SERIAL-nnn															
0x0360	CONNUM				YMDhms-S				YMDhms-E				MT	CT	CC	CN
0x0370	PRTSIZE				PRTKEY							Reserved(8)				
0x0380					CONNUM0				PRTSIZE(0x0388)				PRTKEY			
0x0390					Reserved(8)								CONNUM0			
	INF(0x0400)															
0x3FFF	BLKID-HD0				Reserved		MCode		Reseved				BLOCK SERIAL			
0x4000	BLKID-A3D				Reserved		MCode		CONNUM0				BLOCK SERIAL			
0x4010	BLOCK SEED								INITILIZATION VECTOR							
0x4020	SU-000(Nbyte=384byte)															
0x41A0	SU-001(Nbyte)															
0x4320	SU-002(Nbyte)															
0x04A0	SU-041(Nbyte)															
0x7DA0	Reserved(Nbyte=208byte)															
0x7F20	BLOCK SEED															
0x7FF0	BLKID-A3D				Reserved		MCode		CONNUM0				BLOCK SERIAL			

Fig. 18

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x0000	BLKID-HD0				Reserved		MCode		Reseved				BLOCK SERIAL			
0x0010	N1C+L		N2C+L		INFSIZE		T-PRT		T-SU				INX		XT	
0x0020	NM1(256)															
0x0120	NM2(512)															
0x0310																

Fig. 19

0x0320	Reserved(8)								CONTENTSKEY							
	Reserved(8)								MAC							
	Reserved(12)												A	LT	FNo	
	MG(D)SERIAL-nnn															
0x0360	CONNUM				YMDhms-S				YMDhms-E				MT	CT	CC	CN

Fig. 20

bit7:MODE OF ATRAC3 0:Dual 1:Joint

bit6,5,4 N OF 3 BITS:MODE VALUE

N	MODE	TIME	TRANSMISSION RATE	SU	BYTES
7	HQ	47min	176kbps	31SU	512
6		58min	146kbps	38SU	424
5	EX	64min	132kbps	42SU	384
4	SP	81min	105kbps	53SU	304
3		90min	94kbps	59SU	272
2	LP	128min	66kbps	84SU	192
1	mono	181min	47kbps	119SU	136
0	mono	258min	33kbps	169SU	96

bit3:Reserved

bit2:DATA TYPE	0:AUDIO	1:OTHER
bit1:REPRODUCTION SKIP	0:NORMAL REP	1:SKIP
bit0:EMPHASIS	0:OFF	1:ON(50/15 μS)

Fig. 21

bit7	:COPY PERMISSION	0:COPY PROHIBITION	1:COPY PERMISSION
bit6	:GENERATION	0:ORIGINAL	1:FIRST OR LATER COPY GENERATION
HCMS bit5-4	:COPY CONTROL FOR HIGH SPEED DIGITAL COPY		
	00:COPY PROHIBITION	01:COPY FIRST GENERATION	10:COPY PERMISSION
	COPY OPERATION OF CHILD OF FIRST COPY GENERATION IS PROHIBITED.		
bit3-2	MagicGate AUTHENTICATION LEVEL		
	00:Level10(Non-MG)	01:Level1	
	10:Level2	11:Reserved	
	DIVIDE AND COMBINE ARE PROHIBITED IN OTHER THAN LEVEL 10.		
bit1,0	Reserved		

Fig. 22

0x0370	PRTSIZE	PRTKEY		Reserved(8)
0x0380		CONNUM0	PRTSIZE(0x0388)	PRTKEY
0x0390		Reserved(8)		CONNUM0

Fig. 23

0x4000	BLKID-A3D	Reserved	MCode	CONNUM0	BLOCK SERIAL
0x4010	BLOCK SEED			INITILIZATION VECTOR	
0x4020	SU-000(Nbyte=384byte)				

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Fig. 24A

Fig. 24
Fig. 24A
Fig. 24B
Fig. 24C

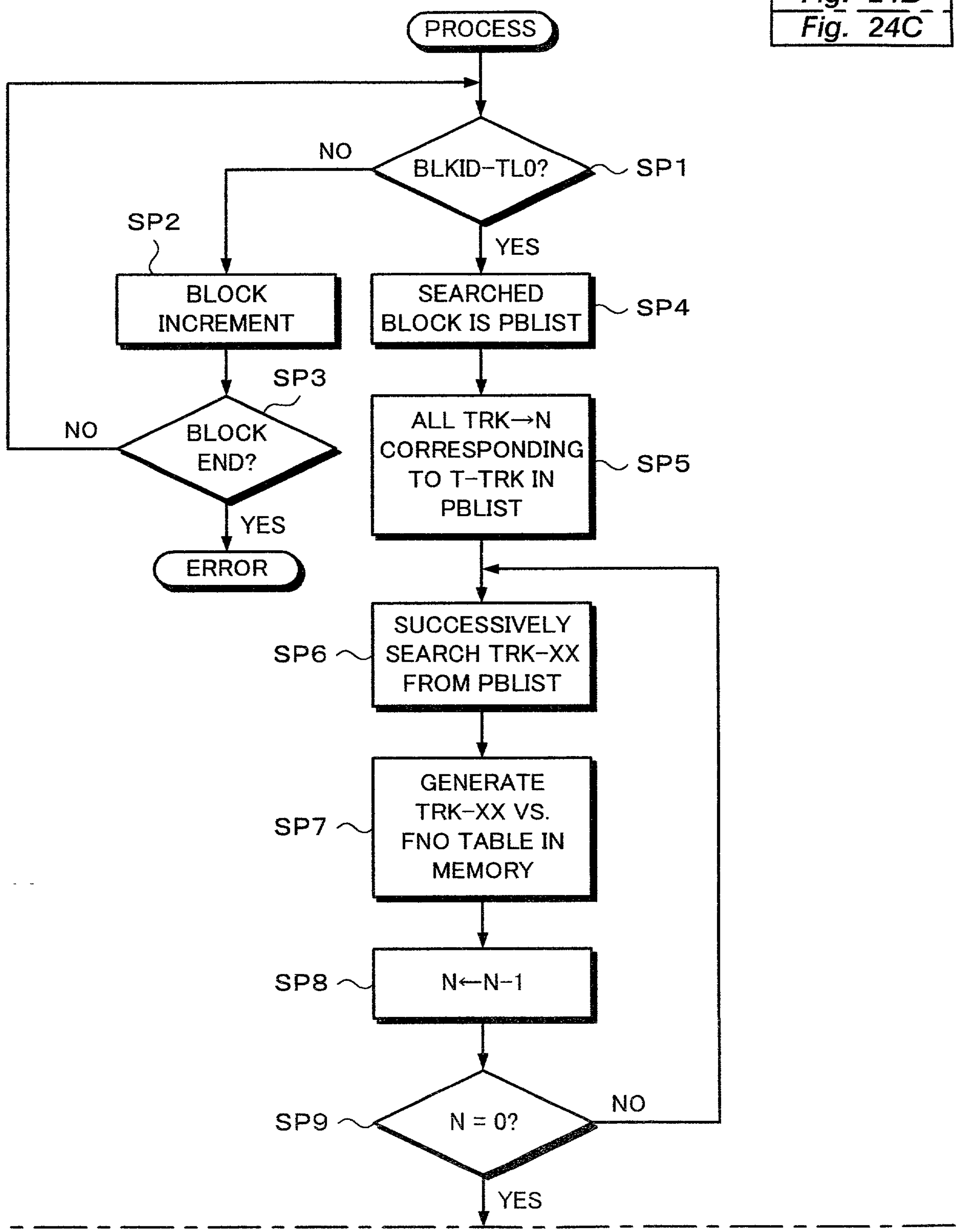

Fig. 24B

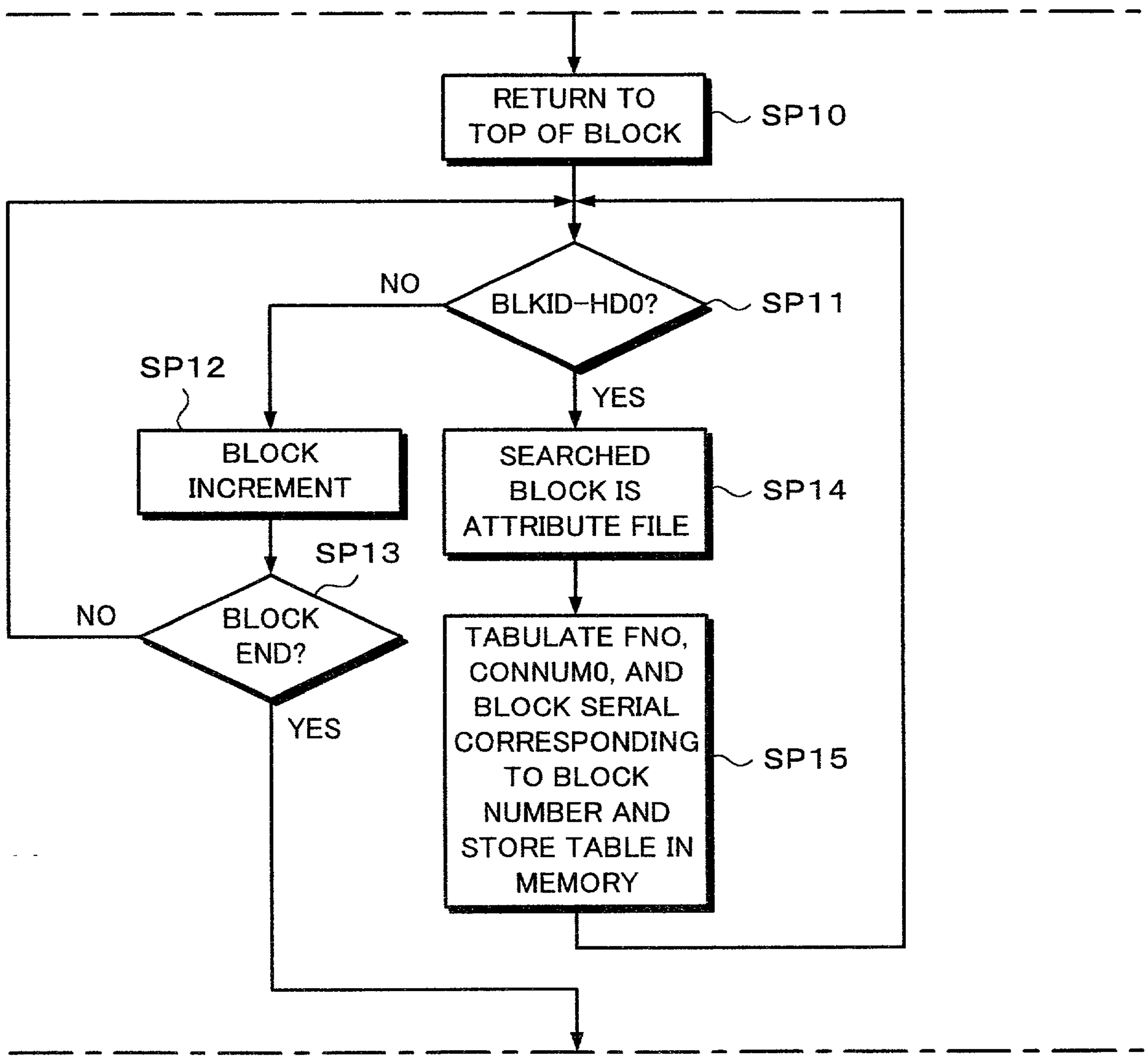
RETURN TO TOP OF BLOCK
SP10
BLKID-HD0?
SP11
NO
YES
SP12
BLOCK INCREMENT
SEARCHED BLOCK IS ATTRIBUTE FILE
SP14
SP13
BLOCK END?
NO
YES
TABULATE FNO, CONNUM0, AND BLOCK SERIAL CORRESPONDING TO BLOCK NUMBER AND STORE TABLE IN MEMORY
SP15

Fig. 24C

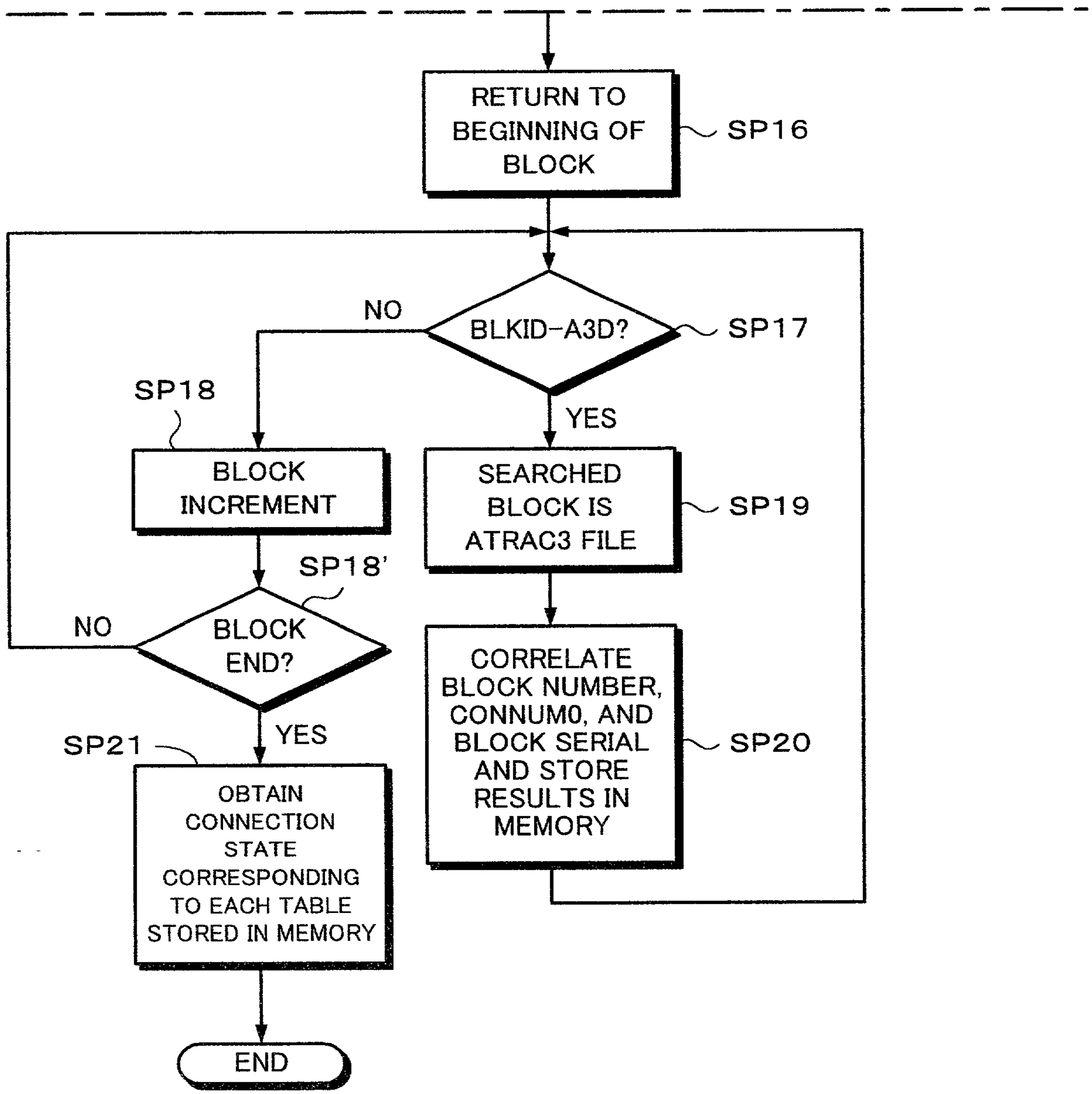
RETURN TO BEGINNING OF BLOCK
SP16
BLKID-A3D?
SP17
NO
YES
SP18
BLOCK INCREMENT
SEARCHED BLOCK IS ATRAC3 FILE
SP19
SP18'
BLOCK END?
NO
YES
CORRELATE BLOCK NUMBER, CONNUM0, AND BLOCK SERIAL AND STORE RESULTS IN MEMORY
SP20
SP21
OBTAIN CONNECTION STATE CORRESPONDING TO EACH TABLE STORED IN MEMORY
END

Fig. 25

- ROOT
  - DCIM ...STILL PICTURE DIRECTORY
  - M0xxxxnn ...MOVING PICTURE DIRECTORY
  - VOICE ...VOICE DIRECTORY
  - AVCTL ...CONTROL DIRECTORY
  - HIFI ...MUSIC DIRECTORY
    - TRKLIST.MSF ...TRACK INFORMATION MANAGEMENT FILE
      CONTAINS POINTERS TO INFORMATION FILES
      FOR TRACK PARTS, NAMES, AND CONTENT KEYS
      - NAME1 ...STICK NAME AND PROGRAM NAME BLOCK (FOR ONE BYTE CODE)
        PROGRAM NAME DATA CORRESPONDING TO
        ASCII/8859-1 CODE
      - NAME2 ...STICK NAME AND PROGRAM NAME BLOCK (FOR TWO BYTE CODE)
        PROGRAM NAME DATA CORRESPONDING TO MS-JIS,
        HANKUL, CHINESE CODE, etc.
    - TRAKLISTB.MSF ...BACKUP TRACK INFORMATION MANAGEMENT FILE
      FULL COPY OF TRKLIST.MSF
    - INFLIST.MSF ...CONTAINS VARIOUS TYPES OF ADDITIONAL INFORMATION
      SUCH AS ARTIST NAME,ISRC CODE, TIME STAMP, STILL
      PICTURE DATA, etc.
    - A3Dnnnnn.MSA ... ATRAC3 PROGRAM DATA FILE
      ~
    - A3Dnnnnn.MSA

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Fig. 26

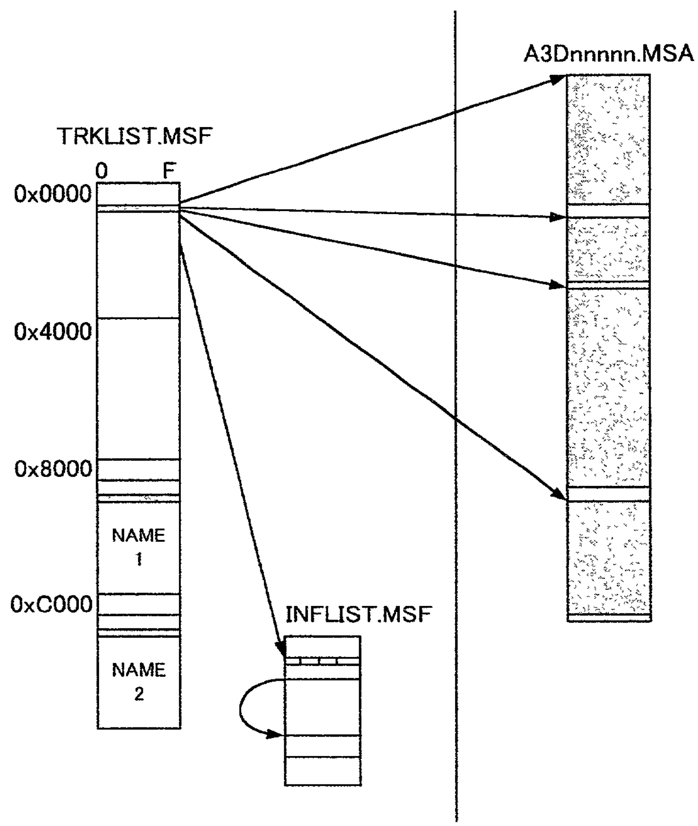


Fig. 27

TRACK INFORMATION MANAGEMENT FILE
(TRKLIST.MSF)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x0000	BLK ID-TL0				T-TRK		MCode		REVISION				YMD h ms			
0x0010	N1	N2	MSID		S-TRK		PASS		APP		INF-S		S_YMD h ms			
0x0020	TRKINF-001															
	PRTINF-001															
	TRKINF-002															
	PRTINF-002															
	⸾															
0x3FF0	BLK ID-TL0						MCode		REVISION							
0x4000	BLK ID-TL1						MCode		REVISION							
	⸾															

DETAIL OF TRKINF-nnn/PRTINF-nnn

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	T0	LT	INF-nnn		FNM-nnn				CONTENTS KEY-nnn							
	MG(D) SERIAL-nnn															
	APP_CTL				CONNUM-nnn				P-nnn		XT		INX-nnn			
	YMDhms-S				YMDhms-E				MT	CT	CC	CN	Reserved			
	PR		A-0000		PRTSIZE-0000				PRTKEY-0000							
	⸾															
	PR		A-nnnn		PRTSIZE-nnnn				PRTKEY-nnnn							
0x7FF0	BLK ID-TL1						MCode		REVISION							

Fig. 28

STICK NAME AND PROGRAM NAME BLOCK-FOR ONE BYTE CODE

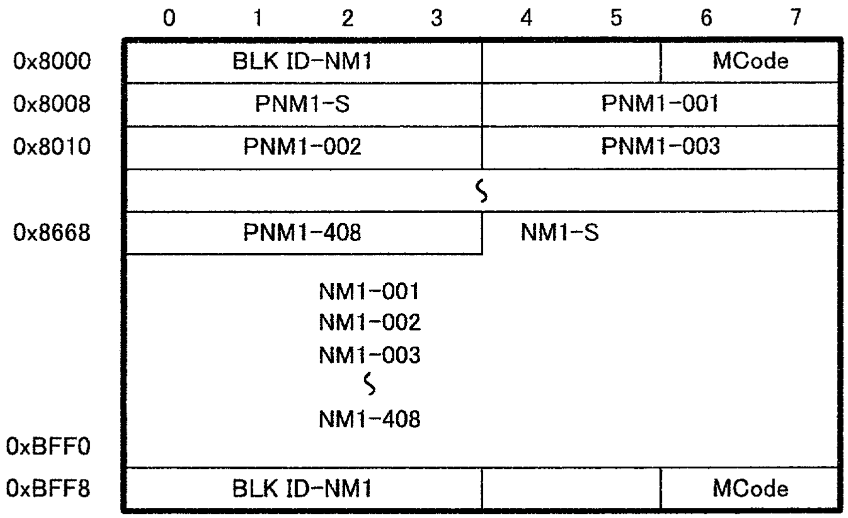


Fig. 29

STICK NAME AND PROGRAM NAME BLOCK-FOR TWO-BYTE CODE

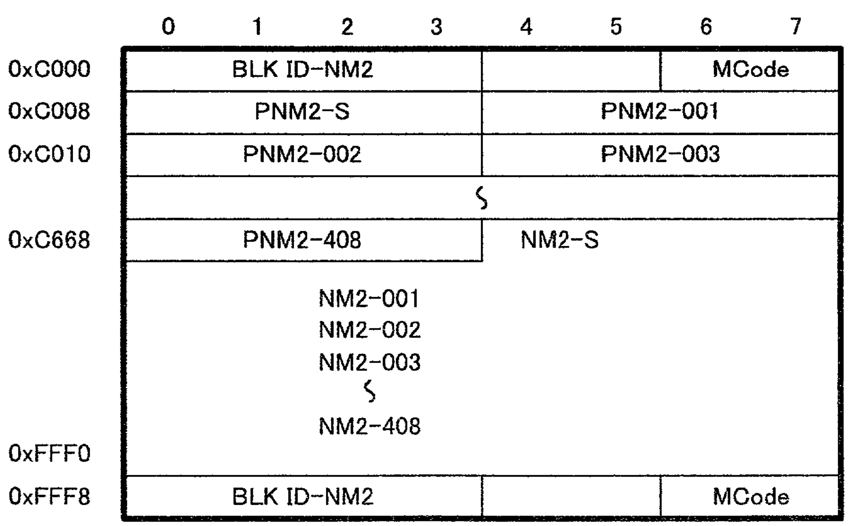


Fig. 30

ATRAC3 DATA FILE (A3Dnnnnn.MSA) ··· 1 SoundUnit=N BYTES

	0	1	2	3	4	5	6	7
0x0000	BLK ID-A3D						MCode	
0x0008	BLOCK SEED							
0x0010	CONNUM0				BLOCK SERIAL			
0x0018	INITILIZATION VECTOR							
0x0020	SU-000 (N byte)							
0x0020 +N/8	SU-001 (N byte)							
	SU-002 (N byte)							
	∫							
	SU-(nnn-1) (N byte)							
0x3FF0 -N/8	Reserved (M byte)							
0x3FF0	BLOCK SEED							
0x3FF8	BLK ID-A3D						MCode	

09/674651

Fig. 31

ADDITIONAL INFORMATION MANAGEMENT FILE (INFLIST.MSF)

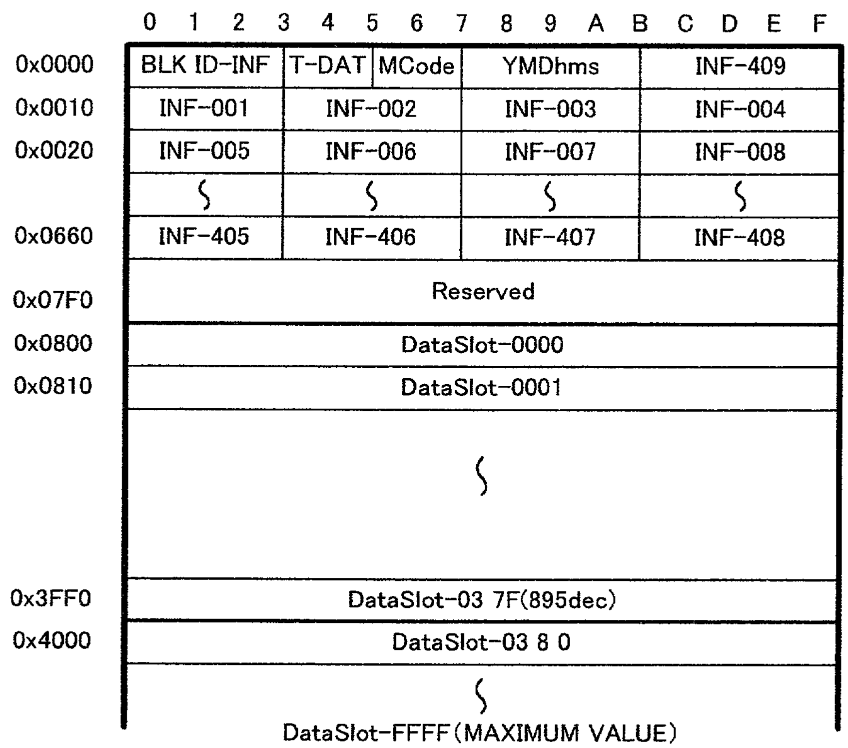


Fig. 32

ADDITIONAL INFORMATION DATA STRUCTURE

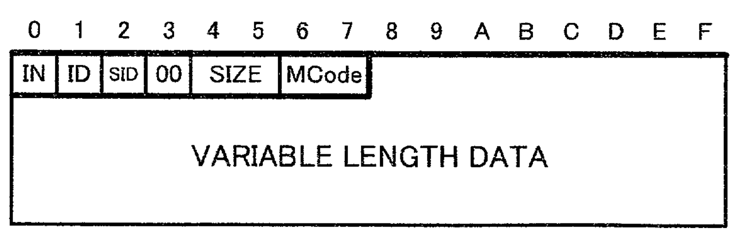


Fig. 33

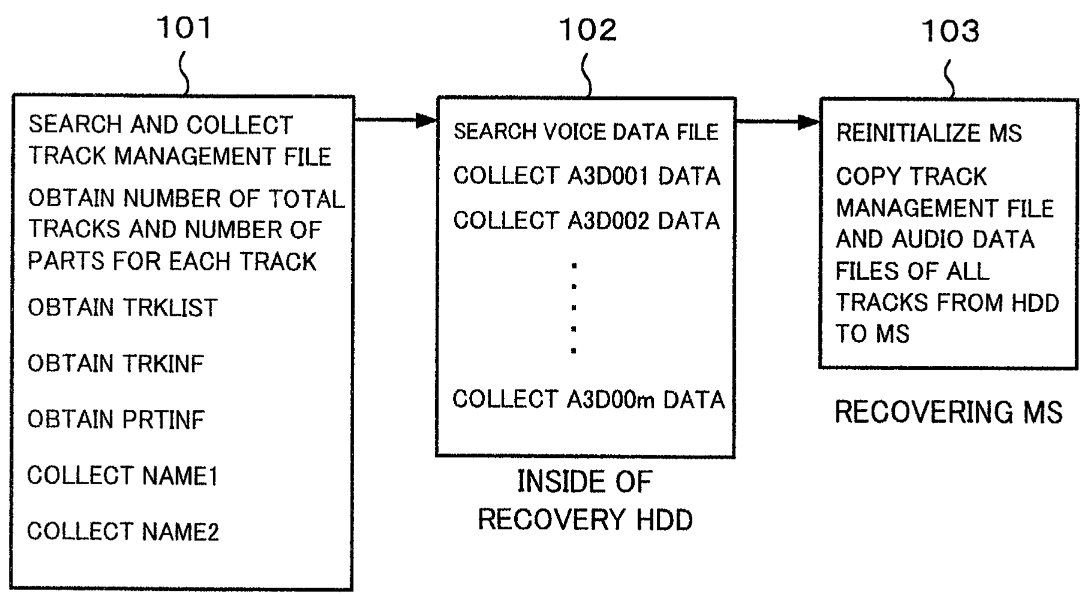

101
SEARCH AND COLLECT TRACK MANAGEMENT FILE
OBTAIN NUMBER OF TOTAL TRACKS AND NUMBER OF PARTS FOR EACH TRACK
OBTAIN TRKLIST
OBTAIN TRKINF
OBTAIN PRTINF
COLLECT NAME1
COLLECT NAME2
102
SEARCH VOICE DATA FILE
COLLECT A3D001 DATA
COLLECT A3D002 DATA
COLLECT A3D00m DATA
INSIDE OF RECOVERY HDD
103
REINITIALIZE MS
COPY TRACK MANAGEMENT FILE AND AUDIO DATA FILES OF ALL TRACKS FROM HDD TO MS
RECOVERING MS

Fig. 34

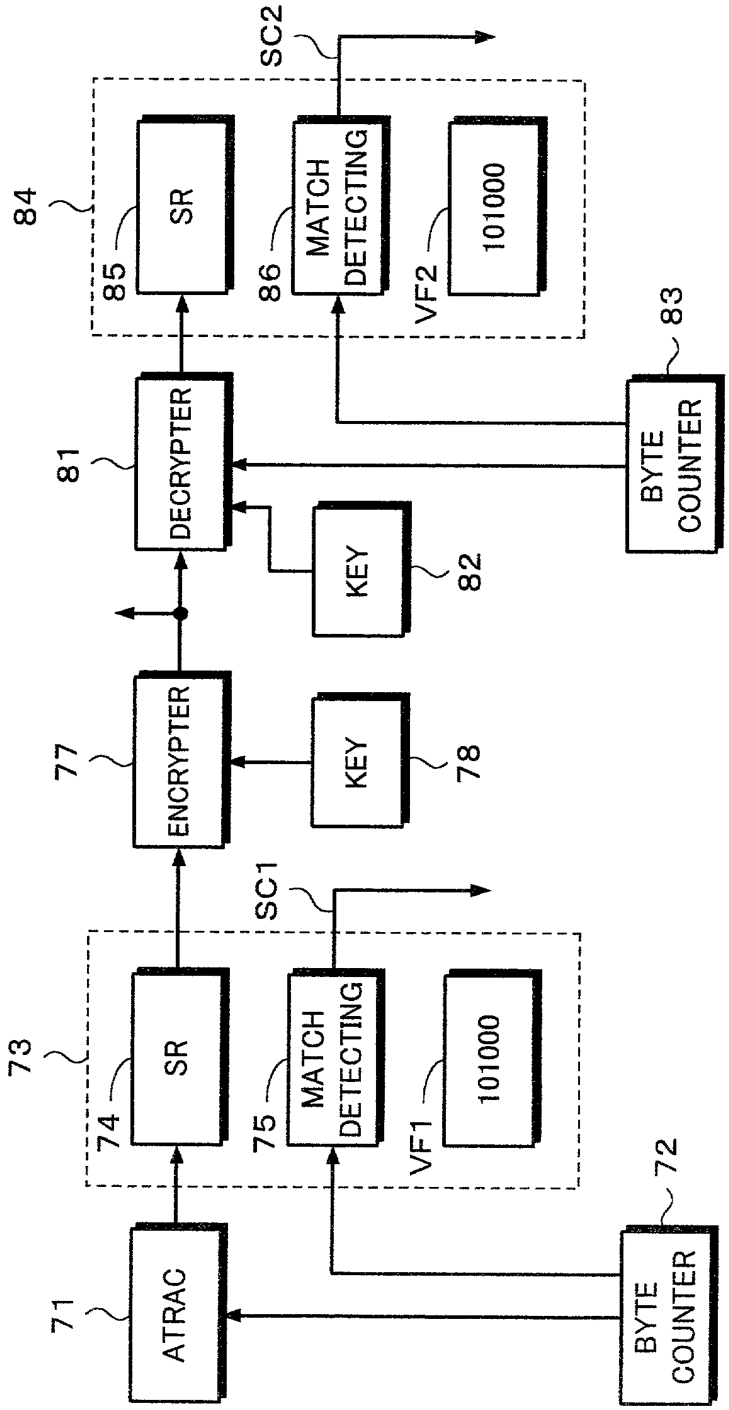

71
ATRAC
72
BYTE COUNTER
73
74
SR
75
MATCH DETECTING
VF1
101000
SC1
77
ENCRYPTER
78
KEY
81
DECRYPTER
82
KEY
83
BYTE COUNTER
84
85
SR
86
MATCH DETECTING
VF2
101000
SC2

Fig. 35

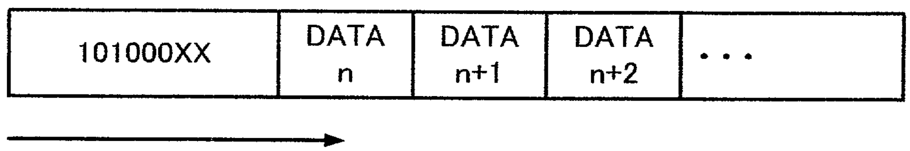

101000XX
DATA n
DATA n+1
DATA n+2
. . .

Fig. 36

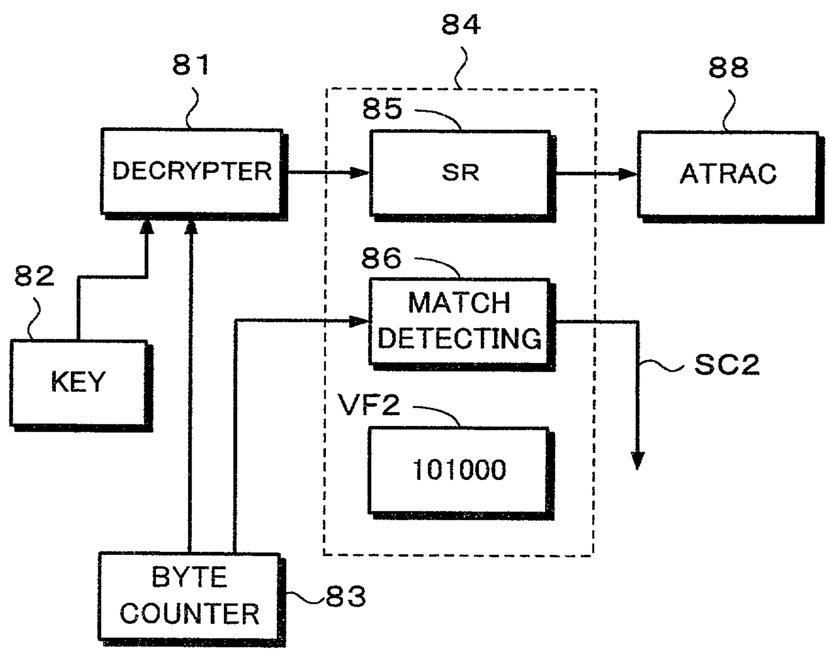
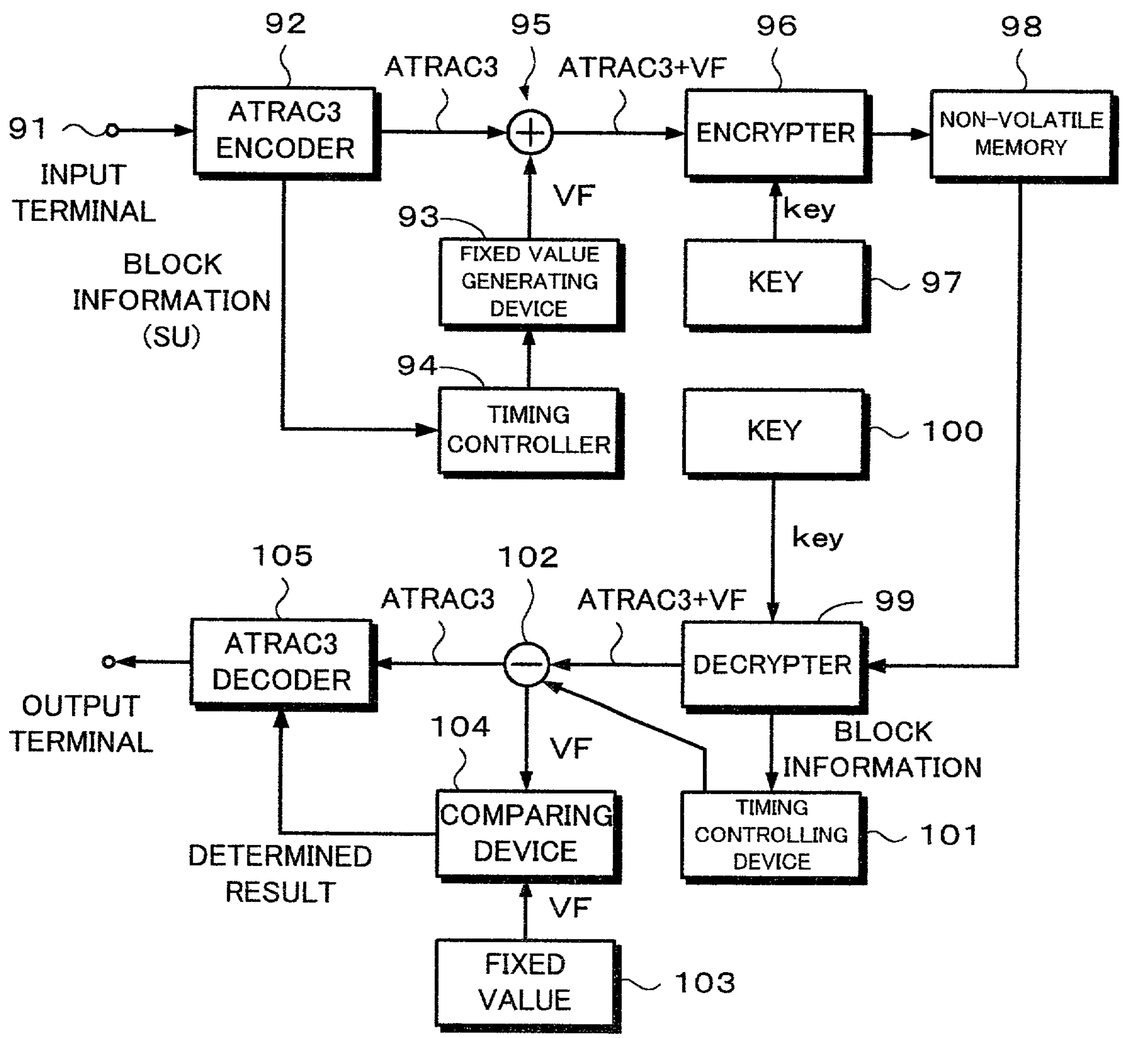

84
81
88
85
DECRYPTER
SR
ATRAC
82
86
MATCH DETECTING
KEY
SC2
VF2
101000
BYTE COUNTER
83

Fig. 37



92
95
96
98
91
INPUT TERMINAL
ATRAC3 ENCODER
ATRAC3
ATRAC3+VF
ENCRYPTER
NON-VOLATILE MEMORY
VF
key
93
FIXED VALUE GENERATING DEVICE
KEY
97
BLOCK INFORMATION (SU)
94
TIMING CONTROLLER
KEY
100
key
105
102
ATRAC3
ATRAC3+VF
99
ATRAC3 DECODER
DECRYPTER
OUTPUT TERMINAL
104
VF
BLOCK INFORMATION
COMPARING DEVICE
TIMING CONTROLLING DEVICE
101
DETERMINED RESULT
VF
FIXED VALUE
103

10	AUDIO ENCODER/DECODER IC
20	SECURITY IC
30	DSP
40	MEMORY CARD
42	FLASH MEMORY
52	SECURITY BLOCK

PBLIST REPRODUCTION MANAGEMENT FILE

TRKLIST TRACK INFORMATION MANAGEMENT FILE

INFLIST ADDITIONAL INFORMATION MANAGEMENT FILE

A3Dnnn AUDIO DATA FILE

PTO/SB 106 (5-00)
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Declaration and Power of Attorney for Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

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As a below names inventor, I hereby declare that:

私の住所、郵便の宛先そして国籍は、私の氏名の後に記載された通りである。

My residence, post office address and citizenship are as stated next to my name:

下記の名称の発明について、特許請求範囲に記載され、且つ特許が求められている発明主題に関して、私は、最初、最先且つ唯一の発明者である（唯一の氏名が記載されている場合）か、或いは最初、最先且つ共同発明者である（複数の氏名が記載されている場合）と信じている。

I believe I am the original, first and sole inventor if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled. Recording Apparatus, Recording Method, Reproducing Apparatus, and Reproducing Method

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＿＿＿＿ であり、且つ
＿＿＿＿ の日に補正された出願（該当する場合）

the specification of which is attached hereto unless the following box is checked:

☒ was filed on 3 March 2000
as United States Application Number of
PCT International Application Number PCT/JP00/01272
_____ and was amended on
_____ (if applicable).

私は、上記の補正書によって補正された、特許請求範囲を含む上記明細書を検討し、且つ内容を理解していることをここに表明する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

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Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed)	Priority Not Claimed 優先権主張なし
11-055860	Japan	3 March 1999	☐
11-096282	Japan	2 April 1999	☐
11-178188	Japan	24 June 1999	☐
11-191536	Japan	6 July 1999	☐
11-347474	Japan	7 December 1999	☐
PCT/JP00/01272	PCT	3 March 2000	☐

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(Application No.)
（出願番号）

(Filing Date)
（出願日）

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(Application No.)
（出願番号）

(Filing Date)
（出願日）

(Status: Patented, Pending, Abandoned)
（現況：特許許可、係属中、放棄）

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直通電話連絡先：（氏名及び電話番号）	Direct Telephone Calls to: (212) 588-0800 To the attention of: **WILLIAM S. FROMMER**
唯一または第一発明者氏名	Full name of sole or first inventor Nobuyuki KIHARA
発明者の署名 日付	Inventor's signature Date Nobuyuki Kihara 29 Sep 2000
住所	Residence Tokyo, Japan JPX
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第二共同発明者がいる場合、その氏名	full name of second joint inventor, if any Teppei YOKOTA
第二共同発明者の署名 日付	Second Inventor's signature Date Teppei Yokota 29th Sep 2000
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国籍	Citizenship Japan
郵便の宛先	Post Office Address Sony Corporation 7-35 Kitashinagawa 6-Chome Shinagawa-Ku, Tokyo 141, Japan
（第三以下の共同発明者についても同様に記載し、著名をすること）	(Supply similar information and signature for third and subsequent joint inventors)

日本語宣言書

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書類送付先

直通電話連絡先：（氏名及び電話番号）

第三共同発明者がいる場合、その氏名

第三共同発明者の署名 日付

住所

国籍

郵便の宛先

第四共同発明者がいる場合、その氏名

第四共同発明者の署名 日付

住所

国籍

郵便の宛先

（第五以下の共同発明者についても同様に記載し、署名をすること）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact al business in the Patent and Trademark Office connected therewith (list name and registration number)

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Full name of third joint inventor, if any

3-0

Takumi OKAUE

Third inventor's signature Date

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Fourth Inventor's signature Date

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(Supply similar information and signature for fifth and subsequent joint inventors)